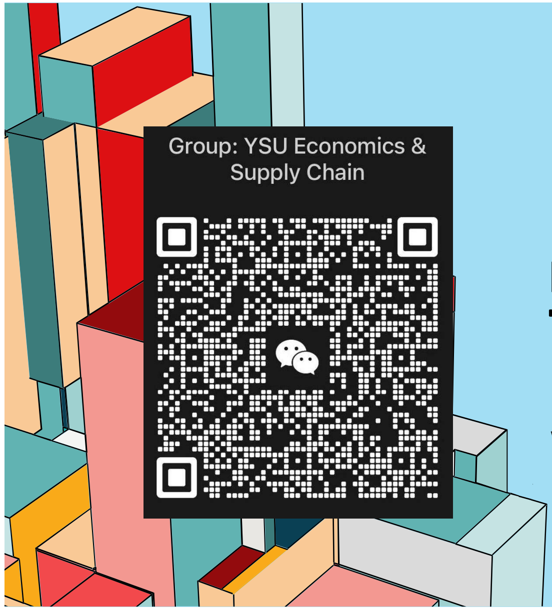

ECONOMICS TOPIC 4

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TOPIC 4: CONSUMER DEMAND AND UNCERTAINTY

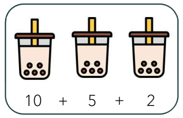
1 MARGINAL UTILITY THEORY

People buy goods and services because they get satisfaction from them.
This satisfaction is called '**utility**'. Business managers are interested in finding out what influences customers to consume or to increase their utility, assuming that consumers behave 'rationally'.

Total utility (TU)

The **total** satisfaction that a person gains from all those units of a commodity consumed within a given time period.

If Tracey drank 3 glasses of bubble tea a day, her daily total utility from bubble tea would be the satisfaction derived from those 3 glasses.

TU = 

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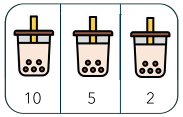
satisfaction

Marginal utility (MU)

The **additional** satisfaction gained from consuming one extra unit within a given time period, assuming that the consumption of other goods is held constant.

Tracy marginal utility is the satisfaction gained from her first, second, or third glass of bubble tea.

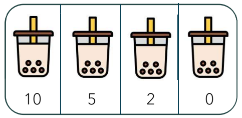


MU MU MU

1 MARGINAL UTILITY THEORY

Principle of diminishing marginal utility

The additional utility gained from consuming successive units of good will decrease, and may eventually become zero or negative.



MU MU MU MU

Tracy marginal utility is **decreasing** from her first, second, or third glass of bubble tea, and eventually become zero on her fourth.

1.1 THE OPTIMUM LEVEL OF CONSUMPTION

Utility is difficult to measure objectively. However, in principle we can measure marginal utility in *monetary terms* as being equal to the **maximum price a person would be prepared to pay** for a good.

Example: If Darren is prepared to pay $12 to obtain an extra glass of bubble tea, then the glass yield him $12 worth of utility:

MU = $12 = the maximum price prepared to pay

How many glasses should he consume if he is to act rationally?
To answer this we need to introduce the concept of **consumer surplus**

Marginal consumer surplus (MCS)

Total consumer surplus (TCS)

1.1 THE OPTIMUM LEVEL OF CONSUMPTION

Marginal consumer surplus (MCS)

The difference between the maximum amount that you are willing to pay for one more unit of a good (marginal utility) and what you are actually charged (price).

MCS = MU – P

Example: If Darren was willing to pay $12 for another glass of bubble tea which in fact cost him only $8, he would be getting a MCS of $4.

MCS = $12 - $8 = $4

Total consumer surplus (TCS)

The total utility gained from the goods consumed (TU) less the total expenditure (TE) on them, ie the excess of what the person would have paid over what they actually paid for the goods.

$TCS = TU - TE = \Sigma MCS$ where TE = P x Q.

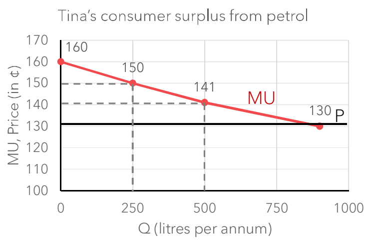
Example: If Darren consumes 3 glasses of bubble tea, and if he'd have been prepared to spend $30 on them and he only had to spend $8 for each glass, then his TCS is $6.

TE = $8 x 3 = $24

TCS = $30 - $24 = $6

1.1 THE OPTIMUM LEVEL OF CONSUMPTION: EXAMPLE

Rational consumer behaviour is the attempt to maximise total consumer surplus (TCS).



MCS = MU – P

Assuming that the current petrol price is 130c per litre, calculate Tina's marginal consumer surplus (MCS) at:

(i) The first few litres

MCS ≈ 160c – 130c ≈ 30c

(ii) 250th litre

MCS =150c – 130c = 20c

(iii) 500th litre

MCS =141c – 130c = 11c

(iv) 900th litre

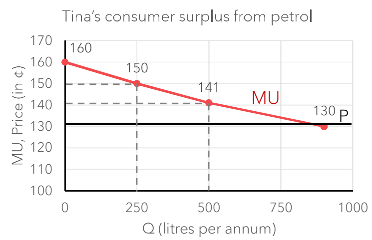
MCS =130c – 130c = 0 (Maximum TCS at MU = P)

∴ It's rational for Tina to buy 900 litres of petrol, where her TCS is at a maximum

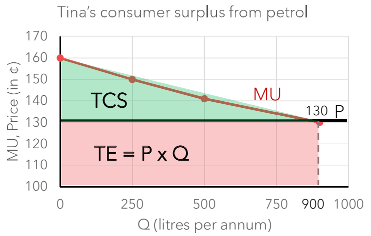
1.1 THE OPTIMUM LEVEL OF CONSUMPTION

General rule for maximising TCS

1. If **MU > P**, the consumer **should buy more**.
2. **TCS is maximised where MU = P**, ie people should consume a good up to the point where MU = P.



1.1 THE OPTIMUM LEVEL OF CONSUMPTION: EXAMPLE



Tina buys 900 litres of petrol at 130c per litre, calculate:

- Total expenditure, TE

  TE = 900 x 130c = 117,000c = $1,170

- Total consumer surplus, TCS

  TCS = ½ x 900 x (160-130) = 13,500c = $135

- Total utility, TU

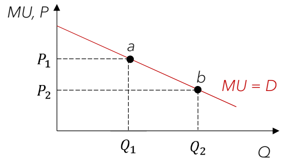
  TCS = TU - TE

  TU = TE + TCS = $1,170 + $135 = $1,305

Note: Tina's TCS is the sum of all the MCS: the sum of all the 900 vertical lines between the price and the MU curve. This is represented by the total area between the P line and the MU curve.

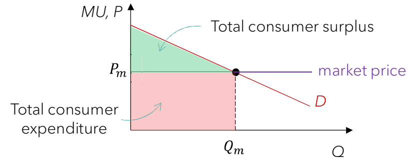
1.2 MARGINAL UTILITY AND THE DEMAND CURVE

An individual person's demand curve



Provided that consumers are rational and maximise consumer surplus where P = MU, then the **demand curve for an individual consumer corresponds to marginal utility curve** measured in money.

Market demand and consumer surplus



The **market demand curve** is the horizontal **sum of all the individual demand curves** and hence MU curves.

A slope reflects PED and MU of the good
Flat curve reflect elastic demand and MU diminishes slowly

2 DEMAND UNDER CONDITIONS OF RISK & UNCERTAINTY

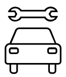
Risk
A situation in which the probabilities of the different possible outcomes are **known**, but it is not known which outcome will occur.

Playing a game of dice
Six possible outcomes, each has a probability of 1/6.

Uncertainty
A situation in which the probabilities of the different possible outcomes are **not known**.

Digging oil in an unexplored area
It's possible to find or not find oil, but the probabilities are unknown.

Imperfect information
People lack info about a **durable good**, which is a good that is consumed over a period of time and involves uncertain future costs. Its future price is also uncertain.

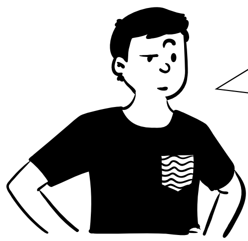


Buying a car
The car will need servicing and repairs of uncertain costs. The car's future market price can also be varied.

2.1 ATTITUDES TOWARDS RISK AND UNCERTAINTY

How will uncertainty affect people's behaviour?

Attitudes towards taking a gamble



I have $105 left to spend this month, and I'm thinking of buying an instant lotto. The ticket costs $5 and there is a 25% chance that it will be a winning ticket. A winning ticket pays a prize of $20. Should I buy a lotto?

Yes 🤑 No 😟 Maybe 🙃

2.1 ATTITUDES TOWARDS RISK AND UNCERTAINTY

Expected value is the anticipated average value for an investment at some point in the future. It is used to estimate the worth of investments relative to their risk.

$$E(X) = \sum_{i=1}^{n} x_i P(x_i)$$

The expected value of the gamble is: E(X) = 0.25(105 – 5 + 20) + 0.75(105-5) = 105

If you do not purchase the ticket then you will have: E(X) = 1(105) = 105

Yes

Risk loving
Always choose to gamble if it had the same expected value as the pay-off from not taking the gamble.

Maybe

Risk neutral
Always choose the option with highest E(X), and feel indifferent when the E(X)s are the same.

No

Risk averse
Never choose to gamble if it had the same expected value as the pay-off from not taking the gamble.

2.2 DIMINISHING MARGINAL UTILITY OF INCOME AND ATTITUDES TO RISK-TAKING

Most people are risk-averse most of the time. This reflects the *principle of diminishing marginal utility*, which suggests that the gain in utility from winning some money is less than the loss of utility from losing the same amount of money.

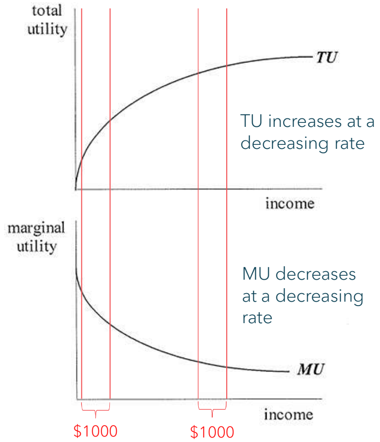
Diminishing marginal utility of income

refers to the situation in which an *individual gains less additional utility from each extra pound of income*. It can be represented by a utility curve, which has a gradient equal to the marginal utility of income.

2.2 DIMINISHING MARGINAL UTILITY OF INCOME AND ATTITUDES TO RISK-TAKING

Diminishing marginal utility of income

an individual gains less additional utility from each extra pound of income (see MU curve).

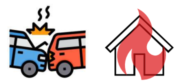


Example:
If people on low incomes earn an extra $1000, they will feel a lot better off: the marginal utility they will get will be very high (TU curve is initially very steep).

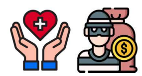
If rich people earn an extra $1000, however, their gain in utility will be less (TU curve is relatively flat at high income).

2.3 INSURANCE: A WAY OF REMOVING RISKS

Risk-averse individuals can buy insurance to remove their exposure to risks. The insurance company is willing to offer insurance primarily because it is able to **spread its risks**.



The spreading of risks

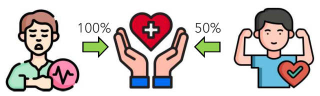


Large number of independent risks:
These are risks with unrelated outcomes so that the occurrence of one does not affect the likelihood of the other occurring (eg automotive, house fire, cancer and theft)

Diversification: Offering lots of different types of insurance against different types of risks in different geographical areas. An insurance company could offer huge product ranges for various locations. with multiple options

Based on the **law of large numbers**, the more insurance policies it sells and the more independent are the risks insured, then the more predictable will be the claims that it faces.

2.4 PROBLEMS FOR UNWARY INSURANCE COMPANIES

	Adverse selection	Moral hazard
Definition	People who know they are bad risks are more inclined to take out insurance than those who know that they are good risks.	A policyholder may, because they have insurance, act in a way that makes the insured event more likely.
Example		
Solutions	Insurance companies will try to: (i) obtain lots of info about potential policyholders, (ii) put them in homogeneous pools, and (iii) charge them appropriate premium.	Introducing penalties if the insured event occurs. For example, (i) setting limits of what and how much you can claim, (ii) making you pay an excess, and (iii) giving no claims discount

3.1 THE EXPECTED UTILITY THEOREM

How can insurance increase my satisfaction (expected utility), and why should I consider (not) getting it?

The **expected utility theorem** says that when making a choice you should choose the course of action that gives the highest expected utility (rather than the highest expected payout).

Suppose that there are $i = 1, \dots, n$ possible outcomes each yielding a wealth of w_i with probability $p(w_i)$ and that the individual obtains utility $U(w_i)$. The individual's expected utility is then given by:

$$\boxed{E\left[U(w)\right] = \sum_{i=1}^{n} U(w_i)p(w_i)}$$

3.1 THE EXPECTED UTILITY THEOREM: EXAMPLE

You own a flat worth \$100,000, and a logarithmic utility function, $U(w) = \ln(w+100)$. There is a 1% probability that your flat will burn down and be worth \$0 (giving a loss of \$100,000) and a 99% probability of no loss. If you take the fire insurance, it costs \$1,200. Should you take out insurance?

With insurance $U(w) = \ln(98{,}800 + 100) = 11.50 = E[U(w)]$ (as $p(w = 98{,}800) = 1$)

Without insurance $p(w = 100{,}000) = 0.99$

$p(w = 0) = 0.01$

$E[U(w)] = \ln(100{,}000 + 100) \times 0.99 + \ln(0 + 100) \times 0.01 = 11.4448$

Since the expected utility with insurance is higher, you should take out insurance – even though your expected wealth is lower if insurance is taken out.

3.1.1 THE BENEFITS TO THE INSURED

Maximising utility is not the same as maximising expected wealth. Because people are risk-averse, the feeling of certainty they get from having insurance gives them extra utility. A utility function, therefore, places less emphasis on highly favorable outcomes compared to expected values.

	Expected Value	Expected Utility
Formula	$E\left[w\right] = \sum_{i=1}^{n} w_i p(w_i)$	$E\left[U(w)\right] = \sum_{i=1}^{n} U(w_i)p(w_i)$
Usage	Straightforward calculation of average outcomes	Decision-making under uncertainty where outcomes have varying levels of **risk** or **satisfaction**
Nature	**Not reflect the diminishing marginal utility** to higher gains	Measuring how each outcome contributes to one's overall satisfaction, which **reflects the diminishing marginal utility** to higher gains.

3.1.2 THE MAXIMUM PREMIUM THE INSURED IS PREPARED TO PAY

Risk-averse individuals are often willing to pay more for insurance than the long-term average value of claims, making insurance economically feasible even if premiums exceed expected claims to cover costs and generate profit.

The maximum premium (P) which as individual, with the initial level of wealth a, will be prepared to pay in order to insure himself against a random loss X is given by:

$$\boxed{E\left[U(\underbrace{a}_{\text{Initial wealth}} - \overbrace{X}^{\text{Potential loss}})\right] = U(a - \underbrace{P}_{\text{Maximum premium}})}$$

3.1.2 THE MAXIMUM PREMIUM THE INSURED IS PREPARED TO PAY: EXAMPLE

The maximum premium (P) can be determined from:

$$\boxed{E\left[U(a - X)\right] = U(a - P)}$$

Previously, you own the flat worth \$100,000 with utility function $U(w) = \ln(w + 100)$.
There is a chance of 1% that it will burn down and be worth \$0. (loss of \$100,000).
Thus, the maximum premium you are prepared to pay is the solution of the equation:

$$0.01\ln(100) + 0.99\ln(100{,}000 + 100) = \ln(100{,}000 - P + 100)$$
$$11.4448 = \ln(100{,}100 - P)$$
$$e^{11.4448} = 100{,}100 - P$$
$$P = 100{,}100 - 93{,}414 = \$6{,}686$$

3.1.3 THE MINIMUM PREMIUM THE INSURER WILL ACCEPT

The insurer faces a number of costs, some of which arise from the risks inherent in the business. These risks have to be paid for via the premium charged.

If the insurer is also risk-averse, then the insurance premium needs to include a margin to compensate the insurer for taking on the risk.

The minimum insurance premium $\boldsymbol{Q}$ which an insurer should be prepared to charge for insurance against a risk with initial wealth of $\boldsymbol{a}$ potential loss $\boldsymbol{Y}$ is given by the solution of the equation:

$$\boxed{E[U(\underbrace{a}_{\text{Initial wealth}} + \overbrace{Q}^{\text{Minimum premium}} - \underbrace{Y}_{\text{Potential loss}})] = U(a)}$$

3.1.3 THE MINIMUM PREMIUM THE INSURER WILL ACCEPT: EXAMPLE

The minimum insurance premium $\boldsymbol{Q}$ is given by the solution of the equation:

$$\boxed{E[U(a + Q - Y)] = U(a)}$$

Suppose that the insurance company has an initial wealth of \$50 million and a utility function:

$$U(w) = w$$

The minimum premium the insurance company will accept to insure a loss of \$100,000 with probability 0.01 can be determined from:

$$0.01(50{,}000{,}000 + Q - 100{,}000) + 0.99(50{,}000{,}000 + Q) = 50{,}000{,}000$$
$$Q = 50{,}000{,}000 - 49{,}999{,}000$$
$$= \$1{,}000$$