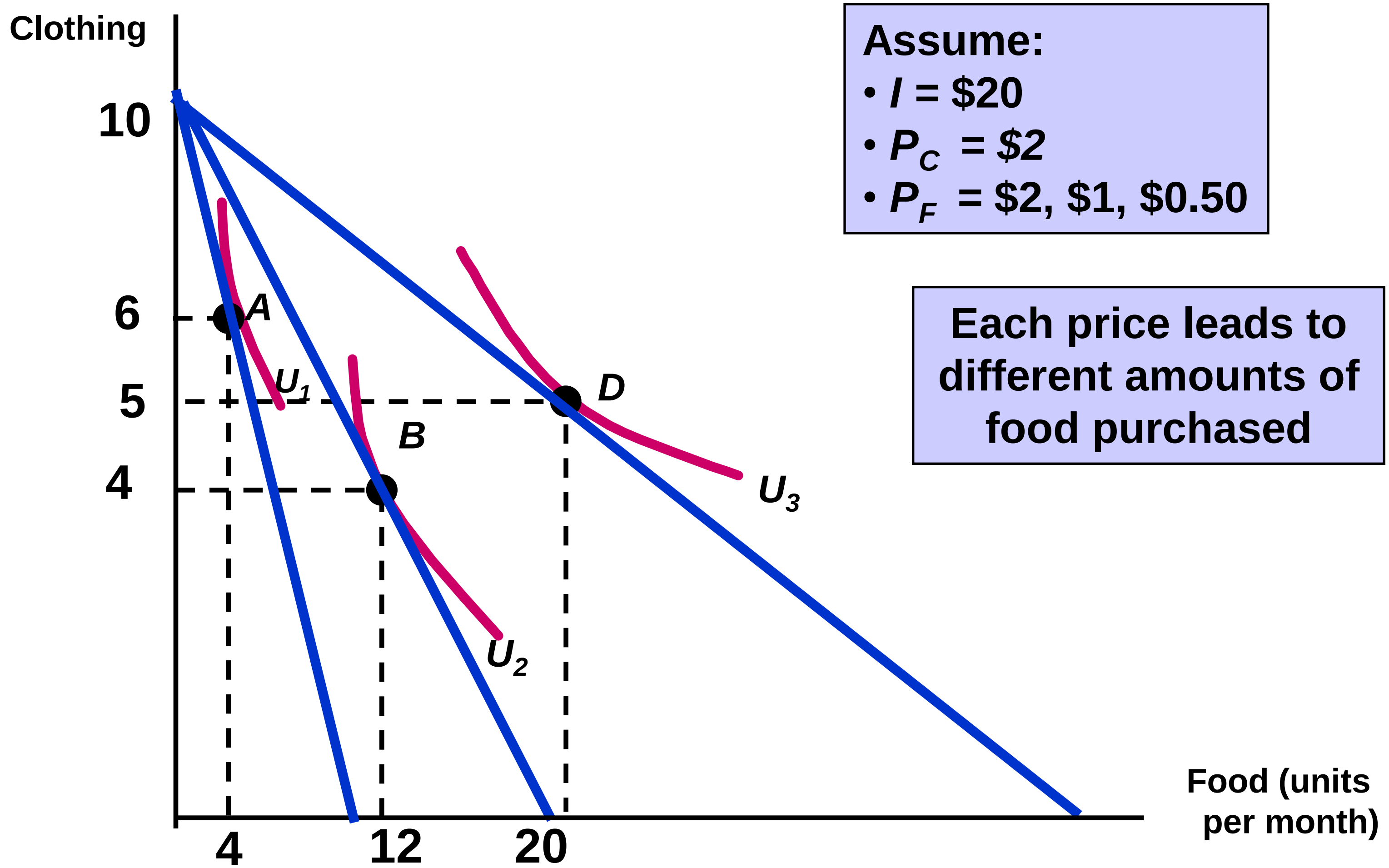
Ch. 4 Individual & Market Demand

- Individual Demand
- Market Demand
- Consumer Surplus

Individual Demand

- Price Changes
  - Using the figures developed in the previous chapter, the impact of a change in the price of food can be illustrated using indifference curves
  - For each price change, we can determine how much of the good the individual would purchase given their budget lines and indifference curves

Effect of a Price Change



Assume:
- ***I*** **= $20**
- ***P_C* = *$2***
- ***P_F*** **= $2, $1, $0.50**

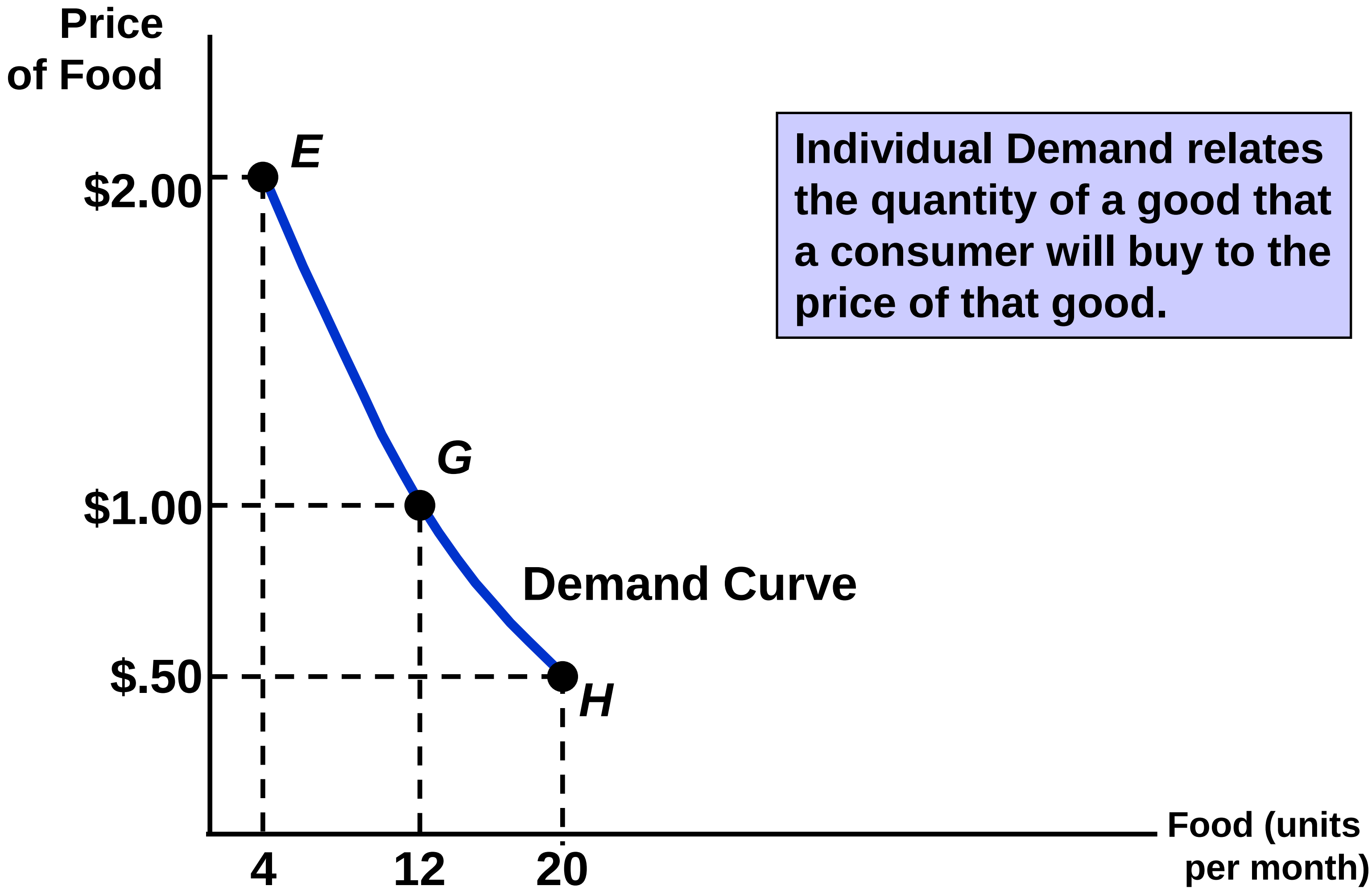
Each price leads to different amounts of food purchased

Effect of a Price Change

- By changing prices and showing what the consumer will purchase, we can create a demand schedule and demand curve for the individual
- From the previous example:

Demand Schedule	
P	Q
$2.00	4
$1.00	12
$0.50	20

Effect of a Price Change

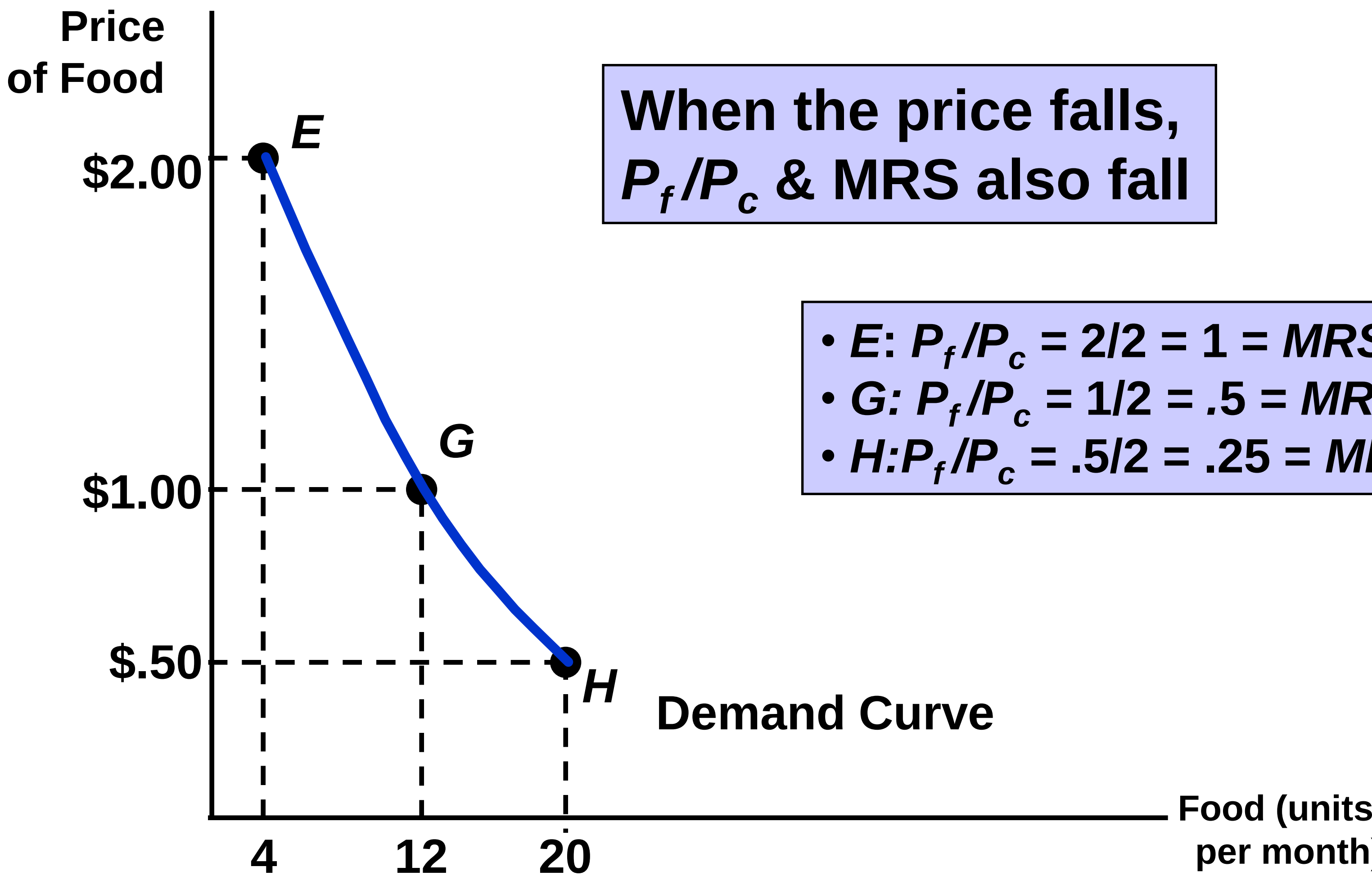


Individual Demand relates the quantity of a good that a consumer will buy to the price of that good.

Demand Curves – Important Properties

- The level of utility that can be attained changes as we move along the curve
- At every point on the demand curve, the consumer is maximizing utility by satisfying the condition that the MRS of food for clothing equals the ratio of the prices of food and clothing

Effect of a Price Change



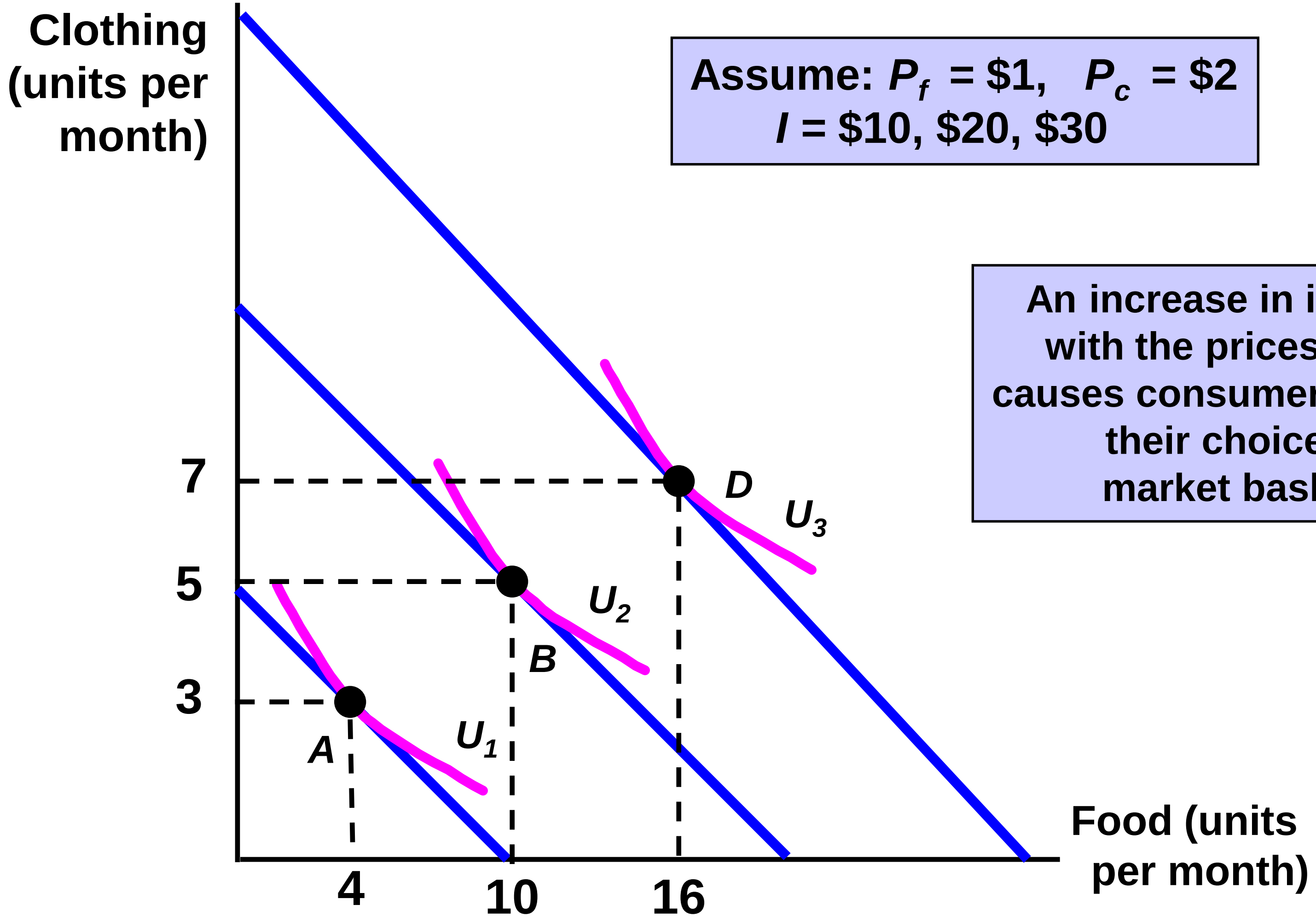
When the price falls, P_f/P_c & MRS also fall

- **E: $P_f/P_c = 2/2 = 1 = MRS$**
- **G: $P_f/P_c = 1/2 = .5 = MRS$**
- **H: $P_f/P_c = .5/2 = .25 = MRS$**

Individual Demand

- Income Changes
  - Using the figures developed in the previous chapter, the impact of a change in the income can be illustrated using indifference curves
  - Changing income, with prices fixed, causes consumers to change their market baskets

Effects of Income Changes



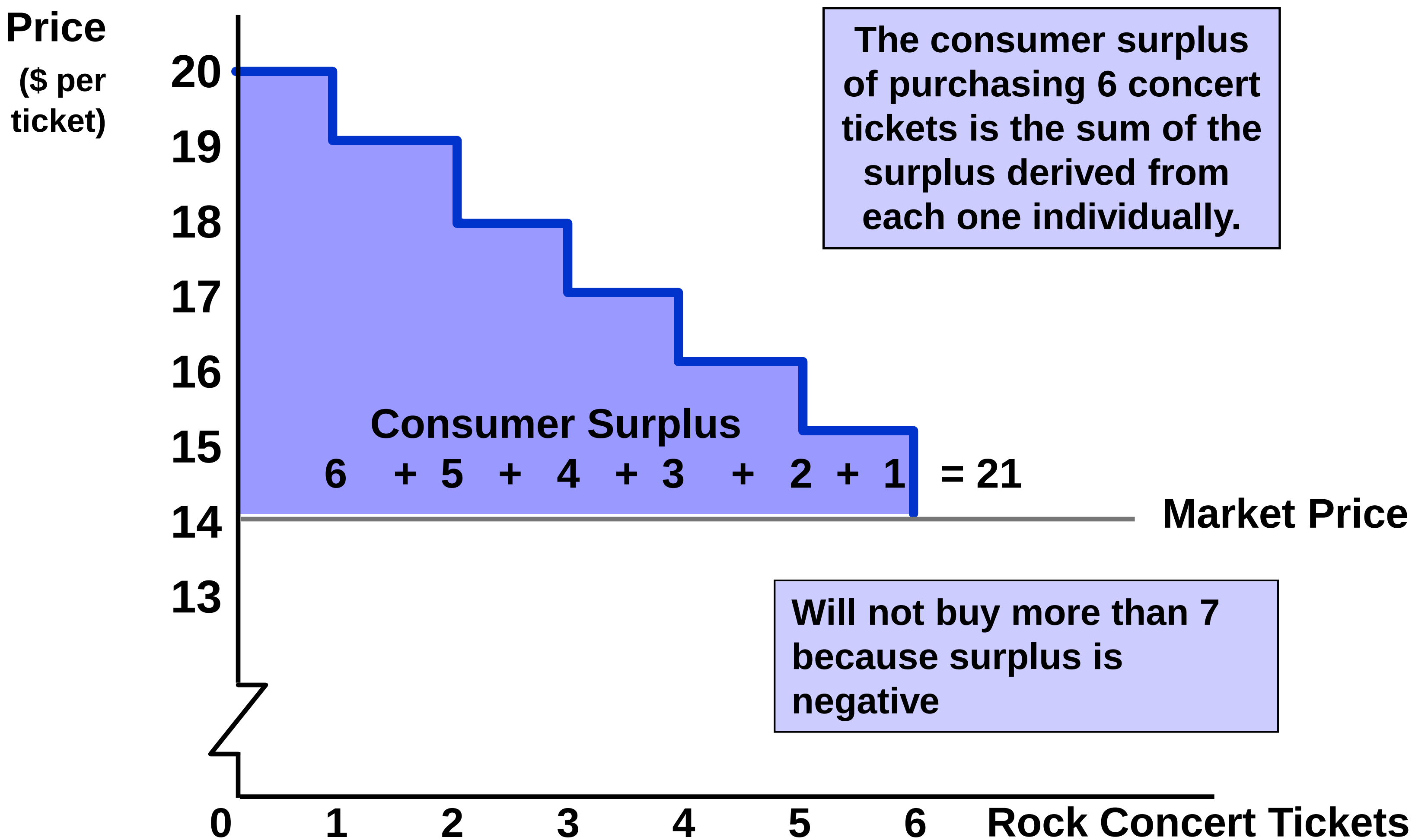
Consumer Surplus

- Consumers buy goods because it makes them better off
- Consumer Surplus measures how much better off they are
  - The difference between the maximum amount a consumer is willing to pay for a good and the amount actually paid
  - Can calculate consumer surplus from the demand curve

Consumer Surplus - Example

- Student wants to buy concert tickets
- Demand curve tells us willingness to pay for each concert ticket
  - 1st ticket worth $20 but price is $14 so student generates $6 worth of surplus
  - Can measure this for each ticket
  - Total surplus is addition of surplus for each ticket purchased

Consumer Surplus - Example



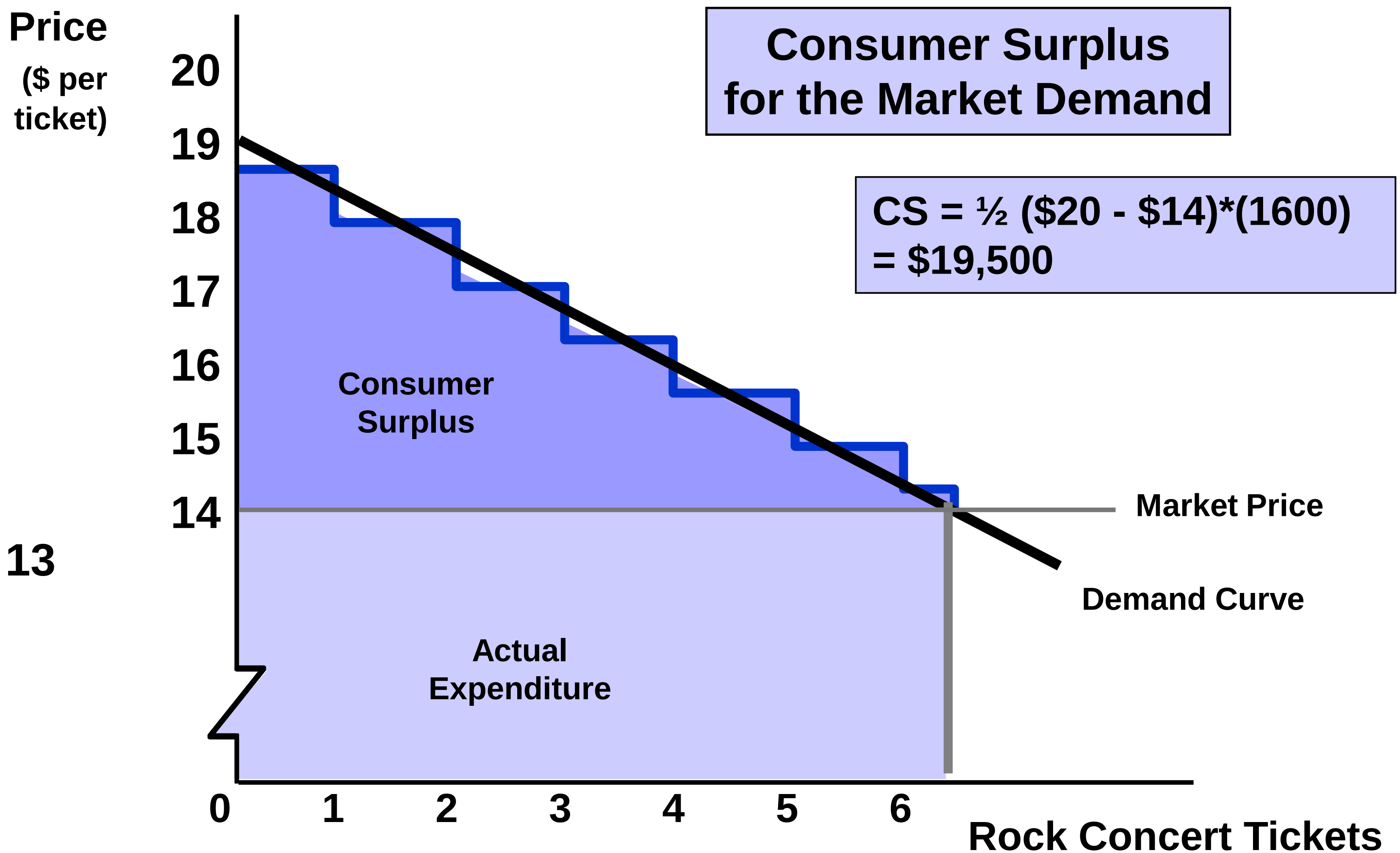
The consumer surplus of purchasing 6 concert tickets is the sum of the surplus derived from each one individually.

Will not buy more than 7 because surplus is negative

Consumer Surplus

- The stepladder demand curve can be converted into a straight-line demand curve by making the units of the good smaller
- Consumer surplus is the area under the demand curve and above the price

Consumer Surplus



Ch. 5 Uncertainty & Consumer Behaviour

- Describing Risk
- Preferences Toward Risk
- Reducing Risk
- Choice with certainty is reasonably straightforward but how do we make choices when certain variables such as income and prices are uncertain (making choices with risk)?

Describing Risk

- To measure risk we must know:

1. All of the possible outcomes
2. The **probability** or likelihood that each outcome will occur

Describing Risk

- Interpreting Probability
  1. Objective Interpretation
     - Based on the observed frequency of past events
  2. Subjective Interpretation
     - Based on perception that an outcome will occur

Interpreting Probability

- Subjective Probability
  - Different information or different abilities to process the same information can influence the subjective probability
  - Based on judgment or experience

Describing Risk

- With an interpretation of probability, must determine 2 measures to help describe and compare risky choices
  1. Expected value
  2. Variability

Describing Risk – Expected Value

- Expected Value
  - The weighted average of the payoffs or values resulting from all possible outcomes
    - Expected value measures the central tendency; the payoff or value expected on average
- (e.g.) Investment in offshore drilling exploration:
- Two outcomes are possible
  - Success – the stock price increases from $30 to $40/share
  - Failure – the stock price falls from $30 to $20/share

Describing Risk – Expected Value

- Objective Probability
  - 100 explorations, 25 successes and 75 failures
  - Probability (Pr) of success = 1/4 and the probability of failure = ¾
  - EV = Pr (success) (value of success) +
    Pr (failure) (value of failure)

  EV = ¼ ($40/share) + 3/4 ($20/share)

  EV = $25/share

Describing Risk - Expected Value

- In general, for n possible outcomes:
  - Possible outcomes having payoffs X_1, X_2, …, X_n
  - Probabilities of each outcome is given by Pr_1, Pr_2, …, Pr_n

$$\boxed{E(X) = Pr_1 X_1 + Pr_2 X_2 + \ldots + Pr_n X_n}$$

Describing Risk - Variability

- Variability
  - The extent to which possible outcomes of an uncertain event may differ
  - How much variation exists in the possible choice
  - (e.g.) Suppose you are choosing between two part-time sales jobs that have the same expected income ($1,500)
- The first job is based entirely on commission
- The second is a salaried position

Describing Risk - Variability

- There are two equally likely outcomes in the first job: $2,000 for a good sales job and $1,000 for a modestly successful one
- The second pays $1,510 most of the time (.99 probability), but you will earn $510 if the company goes out of business (.01 probability)

	Outcome 1		**Outcome 2**	
	Prob.	**Income**	**Prob.**	**Income**
Job 1: Commission	.5	2000	.5	1000
Job 2: Fixed Salary	.99	1510	.01	510

Describing Risk - Variability

- Income from Possible Sales Job

Job 1 Expected Income

$$E(X_1) = .5(\$2000) + .5(\$1000) = \$1500$$

Job 2 Expected Income

$$E(X_2) = .99(\$1510) + .01(\$510) = \$1500$$

Describing Risk - Variability

- While the expected values are the same, the variability is not
- Greater variability from expected values signals greater risk
- Variability comes from **deviations** in payoffs
  - Difference between expected payoff and actual payoff

Variability – An Example

Deviations from Expected Income ($)				
	Outcome 1	**Deviation**	**Outcome 2**	**Deviation**
Job 1	$2000	$500	$1000	-$500
Job 2	1510	10	510	-900

Variability

- Average deviations are always zero so we must adjust for negative numbers
- We can measure variability with **standard deviation**
  - The square root of the average of the squares of the deviations of the payoffs associated with each outcome from their expected value

Variability

- Standard deviation is a measure of risk
  - Measures how variable your payoff will be
  - More variability means more risk
  - Individuals generally prefer less variability – less risk
- The standard deviation is written:

$$\boldsymbol{\sigma} = \sqrt{\Pr_1\left[\boldsymbol{X}_1 - \boldsymbol{E}(\boldsymbol{X})\right]^2 + \Pr_2\left[\boldsymbol{X}_2 - \boldsymbol{E}(\boldsymbol{X})\right]^2}$$

Standard Deviation – Example 1

Deviations from Expected Income ($)				
	Outcome 1	**Deviation**	**Outcome 2**	**Deviation**
Job 1	$2000	$500	$1000	-$500
Job 2	1510	10	510	-900

Standard Deviation of Both Jobs

- $\sigma = \sqrt{Pr_1[X_1 - E(X)]^2 + Pr_2[X_2 - E(X)]^2}$
- $\sigma_1 = \sqrt{0.5(2000 - 1500)^2 + 0.5(1000 - 1500)^2}$
- $\sigma_1 = \sqrt{0.5(500)^2 + 0.5(-500)^2}$
- $\sigma_1 = \sqrt{0.5(250000) + 0.5(250000)}$
- $\sigma_1 = \sqrt{(250000)}$
- ***$\sigma_1 = 500$***
- $\sigma_2 = \sqrt{0.99(1510 - 1500)^2 + 0.01(510 - 1500)^2}$
- $\sigma_2 = \sqrt{0.99(10)^2 + 0.01(-990)^2}$
- $\sigma_2 = \sqrt{0.99(100) + 0.01(980100)}$
- $\sigma_2 = \sqrt{0.99(100) + 0.01(980100)}$
- $\sigma_2 = \sqrt{9900}$
- ***$\sigma_2 = 99.50$***

Standard Deviation

- Job 1 has a larger standard deviation and therefore it is the riskier alternative – average person more likely to choose Job 2
- The standard deviation also can be used when there are many outcomes instead of only two
- (e,g.) Job 1 = job in which the income ranges from $1000 to $2000 in increments of $100 that are all equally likely while:
- Job 2 is a job in which the income ranges from $1300 to $1700 in increments of $100 that, also, are all equally likely

Preferences Toward Risk

- Can expand evaluation of risky alternative by considering utility that is obtained by risk
  - A consumer gets utility from income
  - Payoff measured in terms of utility
- (e.g.) A person is earning $15,000 and receiving 13.5 units of utility from the job
- She is considering a new, but risky job
  - 0.50 chance of $30,000
  - 0.50 chance of $10,000

Preferences Toward Risk

- Utility at $30,000 is 18
- Utility at $10,000 is 10
- Must compare utility from the risky job with current utility of 13.5
- To evaluate the new job, we must calculate the **expected utility** of the risky job
- The **expected utility** of the risky option is the sum of the utilities associated with all her possible incomes weighted by the probability that each income will occur

$$E(u) = (\text{Prob. of Utility 1}) *(\text{Utility 1}) + (\text{Prob. of Utility 2})*(\text{Utility 2})$$

Preferences Toward Risk

- The expected is:

$$E(u) = (1/2)u(\$10{,}000) + (1/2)u(\$30{,}000)$$
$$= 0.5(10) + 0.5(18)$$
$$= 14$$

  - E(u) of new job is 14, which is greater than the current utility of 13.5 and therefore preferred

Preferences Toward Risk – Risk Averse Individual

- Risk Averse
  - A person who prefers a certain given income to a risky income with the same expected value
  - The person has a diminishing marginal utility of income
  - Most common attitude towards risk
    - Ex: Market for insurance

Risk Averse - Example

- A person can have a $20,000 job with 100% probability and receive a utility level of 16
- The person could have a job with a 0.5 chance of earning $30,000 and a 0.5 chance of earning $10,000
- Expected Income of Risky Job

  $$E(I) = (0.5)(\$30,000) + (0.5)(\$10,000) = \$20,000$$

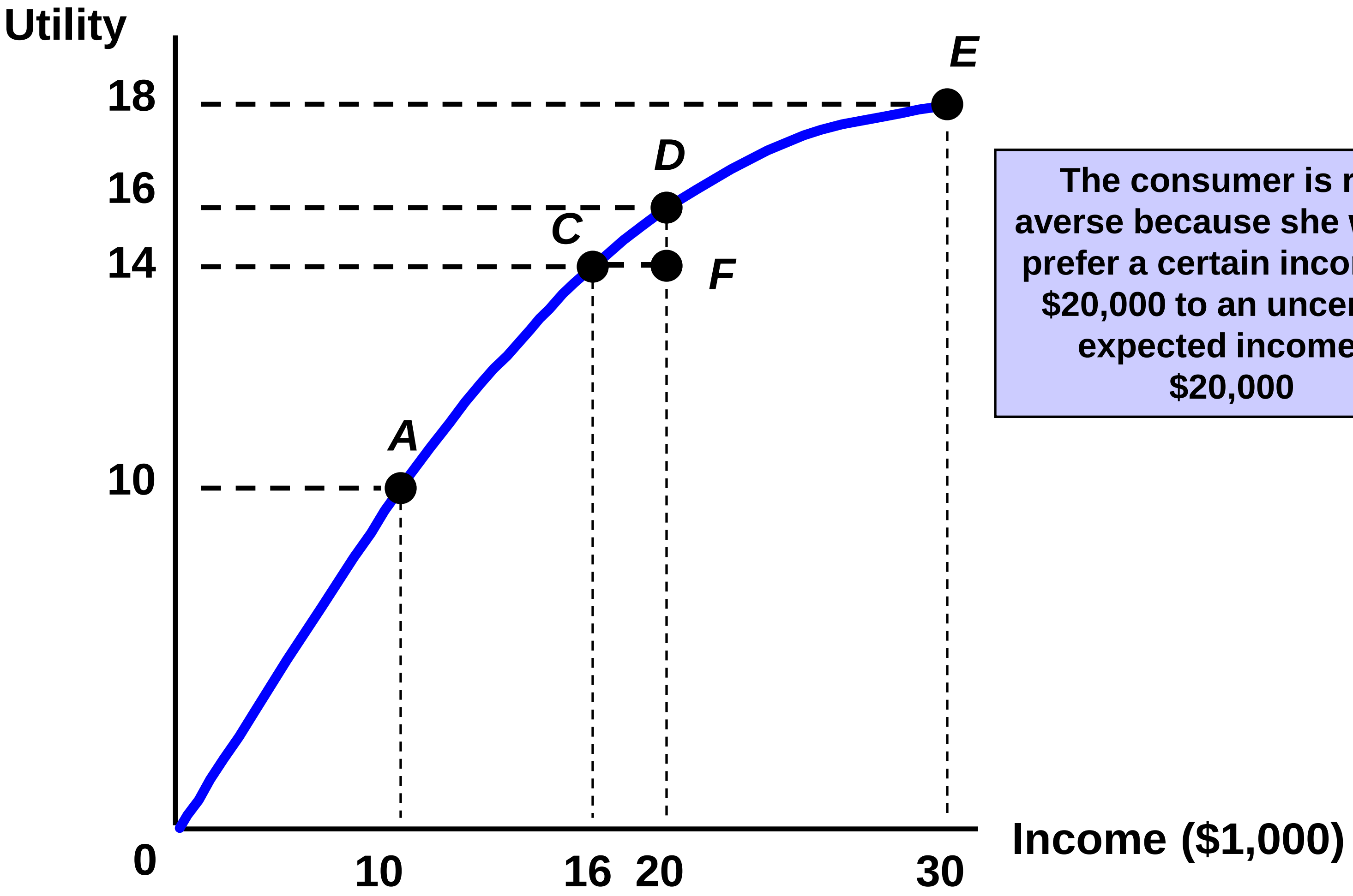
- Expected Utility of Risky Job

  $$E(u) = (0.5)(10) + (0.5)(18) = 14$$

Risk Averse – Example

- Expected income from both jobs is the same – risk averse may choose current job
- Expected utility is greater for certain job
  - Would keep certain job
- Risk averse person's losses (decreased utility) are more important than risky gains
- Can see risk averse choices graphically
- Risky job has expected income = $20,000 with expected utility = 14 (Point F)
- Certain job has expected income = $20,000 with utility = 16
  - Point D

Risk Averse Utility Function



The consumer is risk averse because she would prefer a certain income of $20,000 to an uncertain expected income = $20,000

Preferences Toward Risk – Risk Neutral Individual

- A person is said to be **risk neutral** if they show no preference between a certain income, and an uncertain income with the same expected value
- Constant marginal utility of income
- Expected value for risky option is the same as utility for certain outcome (see next graph)

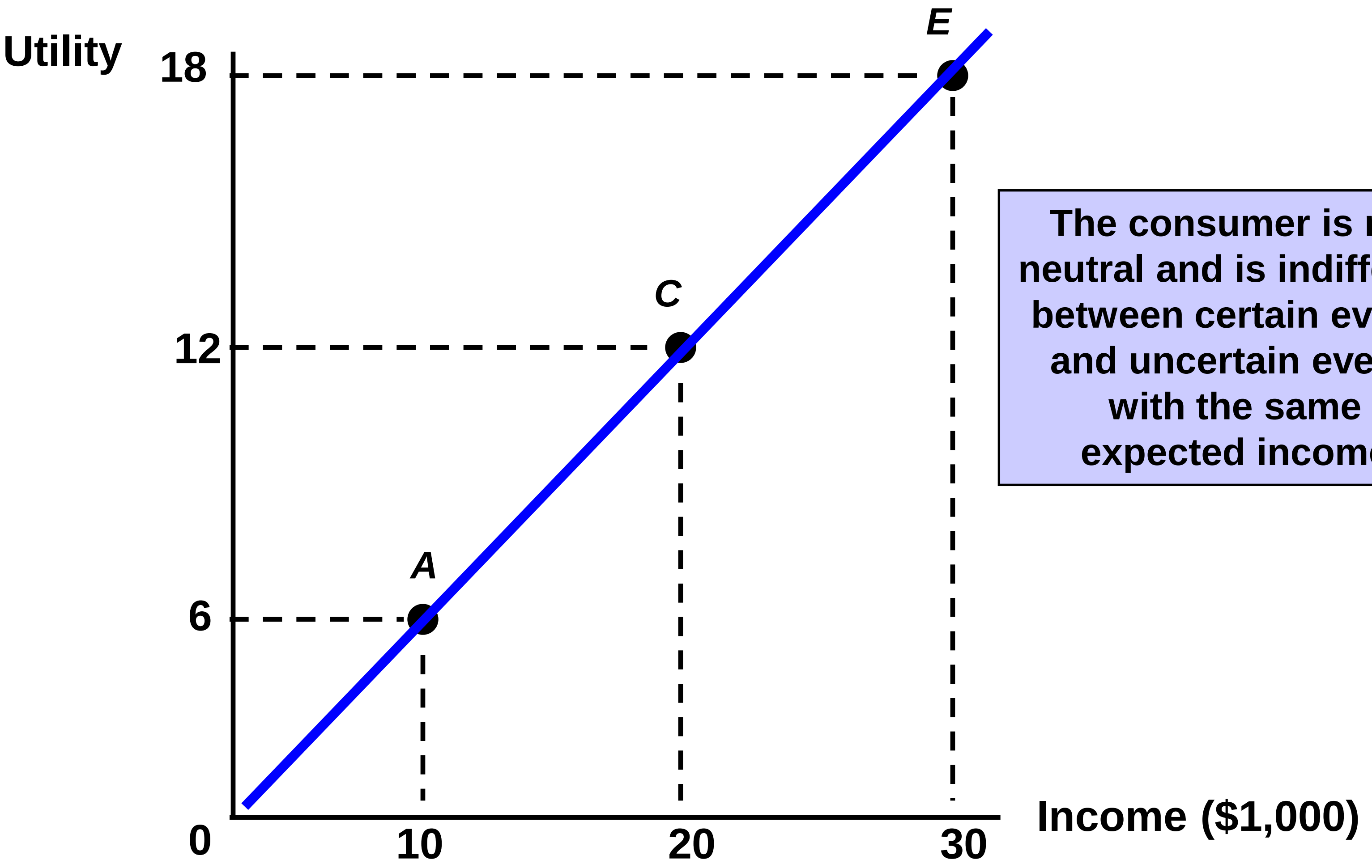
  E(I) = (0.5)($10,000) + (0.5)($30,000)

  = $20,000

  E(u) = (0.5)(6) + (0.5)(18) = 12

- This is the same as the certain income of $20,000 with utility of 12

Risk Neutral



The consumer is risk neutral and is indifferent between certain events and uncertain events with the same expected income.

Preferences Toward Risk – Risk Loving Individual

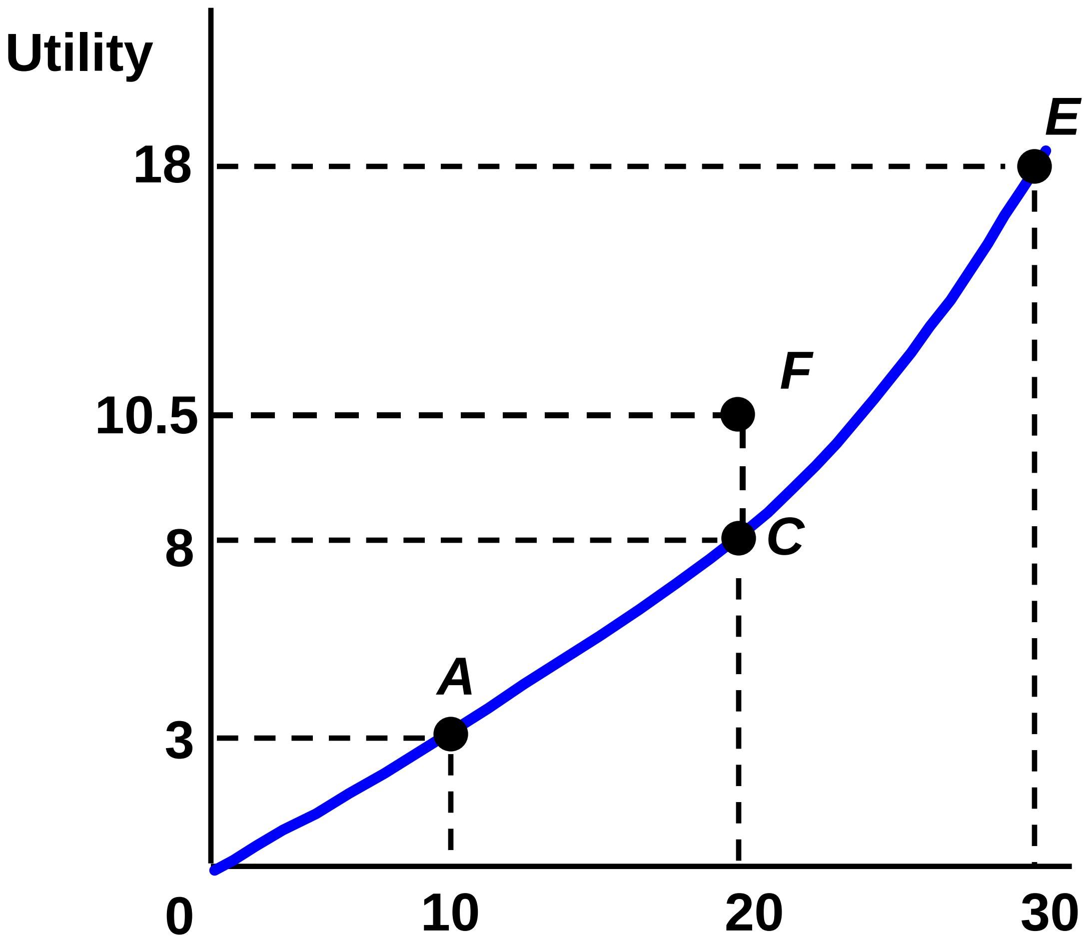
- A person is said to be **risk loving** if they show a preference toward an uncertain income over a certain income with the same expected value
  - Examples: Gambling, some criminal activities
- Increasing marginal utility of income
- Expected value for risky option – point F

  $E(I) = (0.5)(\$10{,}000) + (0.5)(\$30{,}000)$

  $= \$20{,}000$

  $E(u) = (0.5)(3) + (0.5)(18) = 10.5$
- Certain income is $20,000 with utility of 8 – point C
- Risky alternative is preferred

Risk Loving

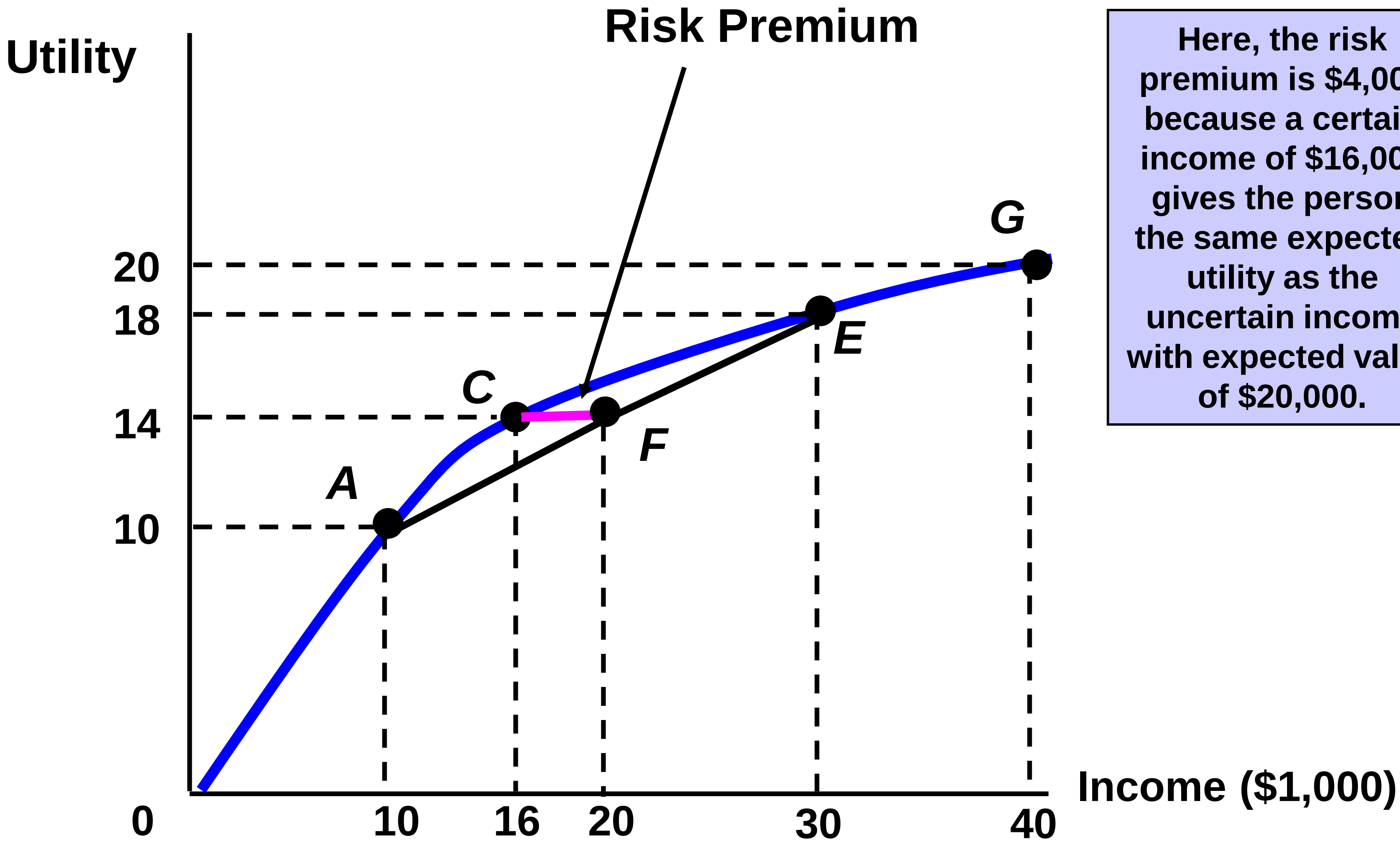


The consumer is risk loving because she would prefer the gamble to a certain income.

Preferences Toward Risk

- The **risk premium** is the maximum amount of money that a risk-averse person would pay to avoid taking a risk
- The risk premium depends on the risky alternatives the person faces
- (e.g.) 50% of earning $30000 & 50% chance of $10000.
- Expected income E (I) = $20000 & Expected Utility E (U) = 14
- Point F shows the risky scenario – the utility of 14 can also be obtained with certain income of $16,000
- This person would be willing to pay up to $4000 (20 – 16) to avoid the risk of uncertain income
- Can show this graphically by drawing a straight line between the two points – line CF

Risk Premium – Example



Here, the risk premium is $4,000 because a certain income of $16,000 gives the person the same expected utility as the uncertain income with expected value of $20,000.

Risk Aversion and Income

- Variability in potential payoffs increases the risk premium
- Example:
  - A job has a .5 probability of paying $40,000 (utility of 20) and a .5 chance of paying 0 (utility of 0).
  - The expected income is still $20,000, but the expected utility falls to 10
    - $E(u) = (0.5)u(\$0) + (0.5)u(\$40{,}000)$

      $= 0 + .5(20) = 10$
  - The certain income of $20,000 has utility of 16
  - If person must take new job, their utility will fall by 6

Risk Aversion and Income

- Example (cont.):
  - They can get 10 units of utility by taking a certain job paying $10,000
  - The risk premium, therefore, is $10,000 (i.e. they would be willing to give up $10,000 of the $20,000 and have the same E(u) as the risky job
- The greater the variability, the more the person would be willing to pay to avoid the risk, and the larger the risk premium

Reducing Risk

- Consumers are generally risk averse and therefore want to reduce risk
- Three ways consumers attempt to reduce risk are:
  1. Diversification
  2. Insurance
  3. Obtaining more information

Reducing Risk

- Diversification
  - Reducing risk by allocating resources to a variety of activities whose outcomes are not closely related
- Example:
  - Suppose a firm has a choice of selling air conditioners, heaters, or both
  - The probability of it being hot or cold is 0.5
  - How does a firm decide what to sell?

Income from Sales of Appliances

	Hot Weather	Cold Weather
Air conditioner sales	$30,000	$12,000
Heater sales	$12,000	$30,000

If the firm sells only heaters or air conditioners their income will be either $12,000 or $30,000
Their expected income would be:

1/2($12,000) + 1/2($30,000) = $21,000

Diversification – Example

- If the firm divides their time evenly between appliances, their air conditioning and heating sales would be half their original values
- If it were hot, their expected income would be $15,000 from air conditioners and $6,000 from heaters, or $21,000
- If it were cold, their expected income would be $6,000 from air conditioners and $15,000 from heaters, or $21,000

Diversification – Example

- With diversification, expected income is $21,000 with no risk
- Better off diversifying to minimize risk
- Firms can reduce risk by diversifying among a variety of activities that are not closely related

Reducing Risk – Insurance

- Risk averse are willing to pay to avoid risk
- If the cost of insurance equals the expected loss, risk averse people will buy enough insurance to recover fully from a potential financial loss
- Assume cost of burglary insurance is $49000

Insurance	Burglary (Pr = .1)	No Burglary (Pr = .9)	Expected Wealth	Standard Deviation
No	40,000	50,000	49,000	3000
Yes	49,000	49,000	49,000	0

Reducing Risk – Insurance

- For the risk averse consumer, guarantee of same income regardless of outcome has higher utility than facing the probability of risk
- Expected utility with insurance is higher than without

The Law of Large Numbers

- Insurance companies know that although single events are random and largely unpredictable, the average outcome of many similar events can be predicted
- When insurance companies sell many policies, they face relatively little risk

Reducing Risk – Actuarially Fair

- Insurance companies can be sure total premiums paid will equal total money paid out
- Companies set the premiums so money received will be enough to pay *expected* losses
- Some events with very little probability of occurrence such as floods and earthquakes are no longer insured privately
  - Cannot calculate true expected values and expected losses
  - Governments have had to create insurance for these types of events
    - Ex: National Flood Insurance Program

The Value of Information

- Risk often exists because we don't know all the information surrounding a decision
- Because of this, information is valuable and people are willing to pay for it
- The value of *complete* information
  - The difference between the expected value of a choice with complete information and the expected value when information is incomplete