



# ECONOMICS ADMISSIONS ASSESSMENT

## CONTENT SPECIFICATION

2017

## Overview

The Economics Admissions Assessment consists of two sections:

**Section 1:** A multiple-choice assessment, comprising approximately 20 problem solving questions and approximately 15 advanced mathematics questions.

The time allowed for Section 1 is 80 minutes.

**Section 2:** An extended essay responding to an excerpt of text.

The time allowed for Section 2 is 40 minutes.

The purpose of the Economics Admissions Assessment is to determine a candidate's potential to achieve in an academically demanding undergraduate degree course. Questions draw upon a candidate's ability to use and apply their reasoning and mathematical knowledge, but require their application in possibly unfamiliar contexts. The assessment is designed to be challenging in order to differentiate effectively between able applicants, including those who may have achieved the highest possible grades in school examinations.

## Format

In Section 1 there will be approximately 35 multiple-choice questions: about 20 Problem Solving questions and about 15 Advanced Mathematics questions. The Problem Solving questions will appear first and be followed by the Advanced Mathematics questions.

Candidates will have 80 minutes in total to complete Section 1 and it is recommended that candidates divide this time evenly between the Problem solving questions and the Advanced Mathematics questions: 40 minutes on the 20 Problem Solving questions and 40 minutes on the 15 Advanced Mathematics questions.

This section will require a soft [HB] pencil and an eraser. Calculators may not be used. Candidates will be issued with an answer sheet on which to indicate their answers. Full instructions will be given at the start of the assessment.

Candidates will have 40 minutes in total to complete Section 2. Candidates will be asked to read a short passage of 1–2 pages and then be asked to write an essay in answer to a question, drawing on the material in the passage and any other ideas which they consider relevant.

Candidates will require a pen for this section and will be issued with an answer booklet in which they will be required to write out their answer. Calculators may not be used. Full instructions will be given at the start of the assessment.

Examples of Problem Solving questions appear in Appendix 1, Part A.

Appendix 2 sets out a single example of an Advanced Mathematics multiple-choice question that candidates might expect to encounter in Section 1, and also sets out an example of an essay question that candidates might expect to encounter in Section 2.

## **Content**

Section 1 of this assessment requires an ability to solve problems, and a knowledge of advanced mathematics. The requirements for each of these are summarised in Appendix 1.

Section 2 will relate to a topic of economic interest (broadly defined). This section of the assessment will not require any knowledge of the specific techniques of economic analysis or factual information about the economy of a particular country.

## **Scoring**

In Section 1, each correct answer will score 1 mark. No marks are deducted for incorrect answers. The marks for each subsection – Problem Solving and Advanced Mathematics – will be equally weighted and reported as separate totals. We recommend candidates split their time equally between each subsection, devoting approximately 40 minutes to each.

In Section 2, the candidate's essay will be assessed taking into account the quality of the candidate's reasoning, and their ability to construct a reasoned, insightful and logically consistent argument with clarity and precision.

## Appendix 1

### Content for the Economics Admissions Assessment

The material that follows outlines the knowledge and skills that Section 1 of the Economics Admissions Assessment could draw upon. **Part A** outlines what skills are expected of candidates for the Problem Solving questions in Section 1, and **Part B** outlines what knowledge is expected of candidates for the Advanced Mathematics questions in Section 1.

## **Part A Problem Solving**

Problem Solving involves reasoning using numerical and spatial skills. The Problem Solving questions in the assessment are of three kinds, each assessing a key aspect of insight into unfamiliar problems. The three kinds of question are Relevant Selection, Finding Procedures, and Identifying Similarity. Although most questions fall into one category, some questions fit into more than one of the categories.

The examples on the following pages show the three kinds of Problem Solving question in the assessment.

### Example 1: Relevant Selection

Very often a real world problem will be overloaded with information, much of which is unimportant. The first step in solving the problem is to decide which bits of the information available are important. It may be that the question has presented you with information which is not important, perhaps redundant, and possibly distracting. This kind of question demands Relevant Selection, in which the task is to select only that information which is necessary and helpful in finding a solution.

The following table gives figures for the percentage growth per year of labour productivity per person per year in various countries during three periods.

	Period 1	Period 2	Period 3
Japan	8.5	3.0	3.2
France	5.4	3.0	2.6
United Kingdom	3.6	1.5	2.4
Belgium	3.3	2.8	2.3
Sweden	4.1	1.5	1.8
Denmark	4.3	2.6	1.7
Italy	6.3	3.0	1.6
Netherlands	4.8	2.7	1.6
Germany	4.5	3.1	1.6
United States	2.2	0.0	0.8

Which country's percentage growth per year was greater than half of its Period 1 level in both Period 2 and 3?

- A Belgium
- B Denmark
- C France
- D Germany
- E United Kingdom

For this question, you need first to be clear what you need to do to find the answer: you must identify which row of the table contains numbers in the 'Period 2' and 'Period 3' columns that are more than half the number in the 'Period 1' column.

By quickly comparing the 'Period 1' and 'Period 2' columns, you can eliminate all but France, Belgium, Denmark, Netherlands and Germany. By comparing 'Period 1' and 'Period 3' you can eliminate all but Belgium. So the correct answer is **A**.

## Example 2: Finding Procedures

Sometimes you will find that even if you have selected all the relevant information, no solution presents itself. Questions of this type often provide you with very little information, all of which may be needed in order to solve the problem. You then have to find a method or procedure which you can use to generate a solution. Typically you will have three or four numbers which have to be operated on. This aspect of Problem Solving is called Finding Procedures.

The 400 seats in a parliament are divided amongst five political parties. No two parties have the same number of seats, and each has at least 20.

What is the largest number of seats that the third largest party can have?

- A 22
- B 118
- C 119
- D 120
- E 121

Five parties share 400 seats. For the third largest party to have the maximum number of seats, the other parties must have the minimum number, whilst still meeting the other conditions set out in the question. So the fourth and fifth largest parties will have 21 and 20 seats respectively. This leaves 359 seats to be divided between the three largest parties.

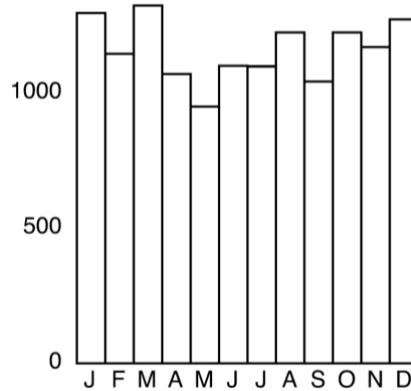
For the third largest party to have as many seats as possible, the other two must have only slightly more seats. If we divide the remaining 359 seats as nearly as possible into thirds, we get: 1st = 120; 2nd = 120; 3rd = 119. However, this violates the condition that no two parties have the same number of seats. To avoid this, one of the seats of the third largest party must be transferred to the largest party.

This gives: 1st = 121; 2nd = 120; 3rd = 118; 4th = 21; 5th = 20. The answer is **B**.

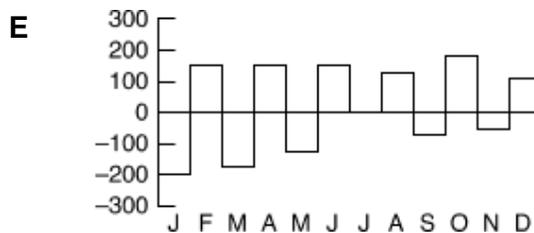
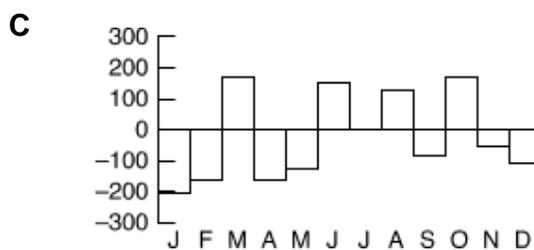
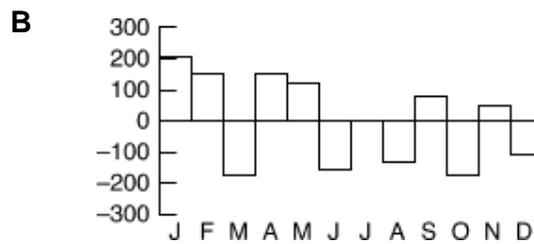
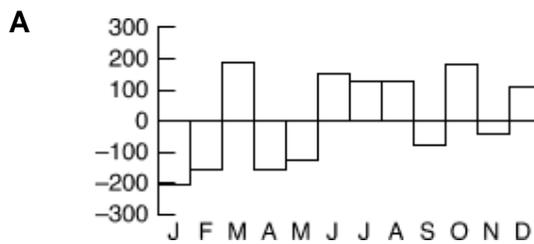
### Example 3: Identifying Similarity

These questions are about being able to recognise data in a different form to that presented. The data is often presented in two different forms such as a table and then some graphs. It may also include spatial reasoning.

The graph below shows a person's bank balance at the end of each month in a year.



Which one of the following graphs could show the actual change in the bank balance each month?



To solve this problem, you must first be clear about how the two types of graph represent the same information. The main graph shows the balance at the end of each month; the graphs in the options show us the *change* in the balance during each month. So, for example, the bar for February in the options represents the difference between the bars for January and February in the main graph.

In the main graph, the balance goes down between the end of January and the end of February, so the bar for February in the options should be negative. A comparison of the options shows that this is true only for options A, C and D, so options B and E can be excluded. By comparing the values for each month in this way, you should find that the correct option is **D**.

## Part B Advanced Mathematics for Economics

The material below outlines the mathematical knowledge that Section 1 of the Economics Admissions Assessment questions can draw upon. The advanced mathematics questions will be primarily based around **B1** to **B9** of what follows, but it will also be assumed that candidates are familiar with the content of **B10** to **B14**.

Throughout this specification, it should be assumed that, where mention is made of a particular quantity, knowledge of the SI unit of that quantity is also expected (including the relationship of the unit to other SI units through the equations linking their quantities). Candidates will be expected to be familiar with the SI prefixes (for the range  $10^{-9}$  (nano) to  $10^9$  (giga)).

### Advanced Mathematics Knowledge for the Economics Admissions Assessment

#### B1 Algebra and functions

- B1.1** Laws of indices for all rational exponents.
- B1.2** Use and manipulation of surds; simplifying expressions that contain surds, including rationalising the denominator; for example, simplifying  $\frac{\sqrt{5}}{3+2\sqrt{5}}$ , and  $\frac{3}{\sqrt{7}-2\sqrt{3}}$ .
- B1.3** Quadratic functions and their graphs; the discriminant of a quadratic function; completing the square; solution of quadratic equations.
- B1.4** Simultaneous equations: analytical solution by substitution, e.g. of one linear and one quadratic equation.
- B1.5** Solution of linear and quadratic inequalities.
- B1.6** Algebraic manipulation of polynomials, including:
- expanding brackets and collecting like terms
  - factorisation and simple algebraic division (by a linear polynomial, including those of the form  $ax + b$ )
  - use of the Factor Theorem and the Remainder Theorem.

#### B2 Sequences and series

- B2.1** Sequences, including those given by a formula for the  $n^{\text{th}}$  term and those generated by a simple recurrence relation of the form  $x_{n+1} = f(x_n)$ .
- B2.2** Arithmetic series, including the formula for the sum of the first  $n$  natural numbers.
- B2.3** The sum of a finite geometric series; the sum to infinity of a convergent geometric series, including the use of  $|r| < 1$ .
- B2.4** Binomial expansion of  $(1 + x)^n$  for positive integer  $n$ ; the notations  $n!$  and  $\binom{n}{r}$ .

**B3 Coordinate geometry in the (x,y) plane**

**B3.1** Equation of a straight line, including  $y - y_1 = m(x - x_1)$  and  $ax + by + c = 0$ ; conditions for two straight lines to be parallel or perpendicular to each other; finding equations of straight lines given information in various forms.

**B3.2** Coordinate geometry of the circle: using the equation of a circle in the forms  $(x - a)^2 + (y - b)^2 = r^2$  and  $x^2 + y^2 + cx + dy + e = 0$ .

**B4 Trigonometry**

**B4.1** The sine and cosine rules, and the area of a triangle in the form  $\frac{1}{2}ab \sin C$ . The sine rule will not include an understanding of the 'ambiguous' case (angle-side-side). Problems will not be set in 3-dimensions.

**B4.2** The sine, cosine, and tangent functions; their graphs, symmetries, and periodicity.

**B4.3** Know and use  $\tan \theta = \frac{\sin \theta}{\cos \theta}$  and  $\sin^2 \theta + \cos^2 \theta = 1$ .

**B5 Exponentials and logarithms**

**B5.1**  $y = a^x$  and its graph, for simple positive values of  $a$ .

**B5.2** Laws of logarithms:

$$a^b = c \Leftrightarrow b = \log_a c$$

$$\log_a x + \log_a y = \log_a(xy)$$

$$\log_a x - \log_a y = \log_a \left( \frac{x}{y} \right)$$

$$k \log_a x = \log_a(x^k)$$

including the special cases:

$$\log_a \frac{1}{x} = -\log_a x$$

$$\log_a a = 1$$

Questions requiring knowledge of the change of base formula will not be set.

**B5.3** The solution of equations of the form  $a^x = b$ , and equations which can be reduced to this form, including those that need prior algebraic manipulation; for example,  $3^{2x} = 4$ , and  $25^x - 3 \times 5^x + 2 = 0$ .

**B6 Differentiation**

**B6.1** The derivative of  $f(x)$  as the gradient of the tangent to the graph  $y = f(x)$  at a point:

- a. interpretation of a derivative as a rate of change
- b. second order derivatives
- c. knowledge of notation:  $\frac{dy}{dx}$ ,  $\frac{d^2y}{dx^2}$ ,  $f'(x)$ , and  $f''(x)$ .

Differentiation from first principles is excluded.

**B6.2** Differentiation of  $x^n$  for rational  $n$ , and related sums and differences. This might include some simplification before differentiating; for example, the ability to differentiate an expression such as  $\frac{(3x+2)^2}{x^{\frac{1}{2}}}$  could be required.

**B6.3** Applications of differentiation to gradients, tangents, normals, stationary points (maxima and minima only), increasing and decreasing functions. Points of inflexion will not be examined.

**B7 Integration**

**B7.1** Definite integration as finding the 'area under a curve.'

**B7.2** Finding definite and indefinite integrals of  $x^n$  for  $n$  rational,  $n \neq -1$ , and related sums and differences, including expressions which require simplification prior to integrating; for example,  $\int (x+2)^2 dx$ , and  $\int \frac{(3x-5)^2}{x^{\frac{1}{2}}} dx$ .

**B7.3** An understanding of the Fundamental Theorem of Calculus and its significance to integration. Simple examples of its use may be required in the two forms,  
 $\int_a^b f(x) dx = F(b) - F(a)$ , where  $F'(x) = f(x)$ , and  $\frac{d}{dx} \int_a^x f(t) dt = f(x)$ .

**B7.4** Combining integrals with either equal or contiguous ranges;  
 for example,  $\int_2^5 f(x) dx + \int_2^5 g(x) dx = \int_2^5 [f(x) + g(x)] dx$   
 and  $\int_2^4 f(x) dx + \int_4^3 f(x) dx = \int_2^3 f(x) dx$ .

**B7.5** Solving differential equations of the form  $\frac{dy}{dx} = f(x)$ .

**B8 Graphs of functions**

- B8.1** Recognise and be able to sketch the graphs of common functions that appear in this specification: these include lines, quadratics, cubics, trigonometric functions, logarithmic functions, and exponential functions.
- B8.2** Know the effect of simple transformations on the graph of  $y = f(x)$  as represented by  $y = af(x)$ ,  $y = f(x) + a$ ,  $y = f(x + a)$ ,  $y = f(ax)$ , with the value of  $a$  positive or negative. Compositions of these transformations.
- B8.3** Understand how altering the values of  $m$  and  $c$  affects the graph of  $y = mx + c$ .
- B8.4** Understand how altering the values of  $a$ ,  $b$  and  $c$  in  $y = a(x + b)^2 + c$  affects the corresponding graph.
- B8.5** Use differentiation to help determine the shape of the graph of a given function; this might include finding stationary points (excluding inflexions) as well as finding when graphs are increasing or decreasing.
- B8.6** Use algebraic techniques to determine where the graph of a function intersects the coordinate axes; appreciate the possible number of real roots a general polynomial can possess.
- B8.7** Geometrical interpretation of algebraic solutions of equations; relationship between the intersections of two graphs and the solutions of the corresponding simultaneous equations.

**B9 The logic of arguments**

**B9.1** Understand and be able to use mathematical logic in simple situations:

- a. the terms *true* and *false*
- b. the terms *and*, *or* (meaning *inclusive or*), *not*
- c. statements of the form:

**if A then B**

**A if B**

**A only if B**

**A if and only if B**

**B9.2** Understand and use the terms *necessary* and *sufficient*.

**B9.3** Understand and use the terms *for all*, *for some* (meaning *for at least one*), and *there exists*.

**B9.4** Being able to negate statements that use any of the above terms.

Note: candidates will not be expected to recognise or use symbolic notations for any of these terms, nor will they be expected to complete formal truth tables.

## Assumed Background Knowledge

### B10 Number

- B10.1** Order, add, subtract, multiply and divide whole numbers, integers, fractions, decimals and numbers in index form.
- B10.2** Use the concepts and vocabulary of factor, multiple, common factor, highest common factor (hcf), least common multiple (lcm), composite (i.e. not prime), prime number, and prime factor decomposition.
- B10.3** Use the terms 'square', 'positive square root' and 'negative square root', 'cube' and 'cube root'.
- B10.4** Use index laws to simplify, multiply, and divide integer, fractional, and negative powers.
- B10.5** Interpret, order and calculate with numbers written in standard index form.
- B10.6** Understand equivalent fractions.
- B10.7** Convert between fractions, decimals and percentages.
- B10.8** Understand and use percentage including repeated proportional change and calculating the original amount after a percentage change.
- B10.9** Understand and use direct and indirect proportion.
- B10.10** Use ratio notation including dividing a quantity in a given ratio, and solve related problems (using the unitary method).
- B10.11** Understand and use number operations, including inverse operations and the hierarchy of operations.
- B10.12** Use surds and  $\pi$  in exact calculations, simplify expressions that contain surds, including rationalising the denominator.
- B10.13** Calculate upper and lower bounds in contextual problems.
- B10.14** Approximate to a specified and appropriate degree of accuracy, including rounding to a given number of decimal places or significant figures.
- B10.15** Know and use approximation methods to produce estimations of calculations.

### B11 Algebra

- B11.1** Distinguish between the different roles played by letter symbols.
- B11.2** Manipulate algebraic expressions by collecting like terms; by multiplying a single term over a bracket; by expanding the product of two linear expressions.
- B11.3** Use index laws in algebra for multiplication and division of integer, fractional, and negative powers.

- B11.4** Set up and solve linear equations, including simultaneous equations in two unknowns.
- B11.5** Factorise quadratics, including the difference of two squares. Simplify rational expressions by cancelling or factorising.
- B11.6** Set up quadratic equations and solve them by factorising.
- B11.7** Set up and use equations to solve problems involving direct and indirect proportion.
- B11.8** Derive a formula, substitute into a formula.
- B11.9** Change the subject of a formula.
- B11.10** Solve linear inequalities in one or two variables.
- B11.11** Generate terms of a sequence using 'term-to-term' and 'position-to-term' definitions.
- B11.12** Use linear expressions to describe the  $n^{\text{th}}$  term of a sequence.
- B11.13** Use Cartesian coordinates in all 4 quadrants.
- B11.14** Recognise the equations of straight lines; understand  $y = mx + c$  and the gradients of parallel lines.
- B11.15** Understand that the intersection of graphs can be interpreted as giving the solutions to simultaneous equations.
- B11.16** Solve simultaneous equations, where one is linear and one is quadratic.
- B11.17** Recognise and interpret graphs of quadratic functions, simple cubic functions, the reciprocal function, trigonometric functions, and the exponential function  $y = k^x$  for simple positive values of  $k$ .
- B11.18** Construct linear functions from real-life problems; interpret graphs modelling real situations.

## **B12 Geometry**

- B12.1** Recall and use properties of angles at a point, on a straight line, perpendicular lines and opposite angles at a vertex.
- B12.2** Understand and use the angle properties of parallel lines, intersecting lines, triangles and quadrilaterals.
- B12.3** Calculate and use the sums of the interior and exterior angles of polygons.
- B12.4** Recall the properties and definitions of special types of quadrilateral.
- B12.5** Understand congruence and similarity.
- B12.6** Use Pythagoras' theorem in 2-dimensions.

**B13 Statistics**

- B13.1** Identify possible sources of bias.
- B13.2** Group, and understand, discrete and continuous data.
- B13.3** Extract data from lists and tables.
- B13.4** Design and use two-way tables.
- B13.5** Interpret bar charts, pie charts, grouped frequency diagrams, line graphs, and frequency polygons.
- B13.6** Interpret cumulative frequency tables and graphs, and histograms (including unequal class width).
- B13.7** Calculate and interpret mean, median, mode, modal class, range, and inter-quartile range, including the estimated mean of grouped data.
- B13.8** Interpret scatter diagrams and recognise correlation; using lines of best fit.
- B13.9** Compare sets of data by using statistical measures or by interpreting graphical representations of their distributions.

**B14 Probability**

- B14.1** Understand and use the vocabulary of probability and the probability scale.
- B14.2** Understand and use estimates or measures of probability, including relative frequency and theoretical models.
- B14.3** List all the outcomes for single and combined events.
- B14.4** Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1.
- B14.5** Construct and use Venn diagrams to solve union and intersection categorisation problems and determine probabilities when required. Familiarity with the meaning and use of the terms 'union', 'intersection', and 'complement' is required.
- B14.6** Know when to add or multiply two probabilities.
- B14.7** Understand the use of tree diagrams to represent outcomes of combined events:
  - a.** when the probabilities are independent of the previous outcome;
  - b.** when the probabilities are dependent on the previous outcome.
- B14.8** Compare experimental and theoretical probabilities.
- B14.9** Understand that if an experiment is repeated, the outcome may be different.

## Appendix 2

### Example questions

#### Section 1: Advanced Mathematics

What is the smallest possible value of  $\int_0^1 (x - a)^2 dx$  as  $a$  varies?

- A  $\frac{1}{12}$
- B  $\frac{1}{3}$
- C  $\frac{1}{2}$
- D  $\frac{7}{12}$
- E 2

**Key: A**

#### Section 2: Essay question and text

Read the extract taken from John Kenneth Galbraith's *The Affluent Society* (1958) and then answer the following:

**What is understood by “the Conventional Wisdom”? Discuss an example of an idea which qualifies as conventional wisdom.**

#### **The Concept of the Conventional Wisdom**

THE FIRST requirement for an understanding of contemporary economic and social life is a clear view of the relation between events and the ideas which interpret them. For each of these has a life of its own and, much as it may seem a contradiction in terms, each is capable for a considerable period of pursuing an independent course.

The reason is not difficult to discover. Economic like other social life does not conform to a simple and coherent pattern. On the contrary, it often seems incoherent, inchoate and intellectually

frustrating. But one must have an explanation or interpretation of economic behavior. Neither man's curiosity nor his inherent ego allows him to remain contentedly oblivious to anything that is so close to his life.

Because economic and social phenomena are so forbidding, or at least so seem, and because they yield few hard tests of what exists and what does not, they afford to the individual a luxury not given by physical phenomena. Within a considerable range, he is permitted to believe what he pleases. He may hold whatever view of this world he finds most agreeable or otherwise to his taste.

As a consequence, in the interpretation of all social life, there is a persistent and never-ending competition between what is right and what is merely acceptable. In this competition, while a strategic advantage lies with what exists, all tactical advantage is with the acceptable. Audiences of all kinds most applaud what they like best. And in social comment, the test of audience approval, far more than the test of truth, comes to influence comment. The speaker or writer who addresses his audience with the proclaimed intent of telling the hard, shocking facts invariably goes on to expound what the audience most wants to hear.

Just as truth ultimately serves to create a consensus, so in the short run does acceptability. Ideas come to be organized around what the community as a whole or particular audiences find acceptable. And as the laboratory worker devotes himself to discovering scientific verities, so the ghost writer and the public relations man concern themselves with identifying the acceptable. If their clients are rewarded with applause, these artisans are deemed qualified in their craft. If not, they have failed. By sampling audience reaction in advance, or by pretesting speeches, articles and other communications, the risk of failure can now be greatly minimized.

Numerous factors contribute to the acceptability of ideas. To a very large extent, of course, we associate truth with convenience – with what most closely accords with self-interest and personal well-being or promises best to avoid awkward effort or unwelcome dislocation of life. We also find highly acceptable what contributes most to self-esteem. Speakers before the United States Chamber of Commerce rarely denigrate the businessman as an economic force. Those who appear before the AFL-CIO are prone to identify social progress with a strong trade union movement. But perhaps most important of all, people approve most of what they best understand. As just noted, economic and social behavior are complex, and to comprehend their character is mentally tiring. Therefore we adhere, as though to a raft, to those ideas which represent our understanding. This is a prime manifestation of vested interest. For a vested interest in understanding is more preciously guarded than any other treasure. It is why men react, not infrequently with something akin to religious passion, to the defense of what they have so laboriously learned. Familiarity may breed contempt in some areas of human behavior, but in the field of social ideas it is the touchstone of acceptability.

Because familiarity is such an important test of acceptability, the acceptable ideas have great stability. They are highly predictable. It will be convenient to have a name for the ideas which are esteemed at any time for their acceptability, and it should be a term that emphasizes this predictability. I shall refer to these ideas henceforth as the Conventional Wisdom.

[Quoted from: *The Affluent Society* (1958) by J.K. Galbraith]

