## 8. RESOURCING DISTANCE-EDUCATION PROJECTS

A significant problem for administrators and planners in institutions teaching at a distance is to explain the cost structures which apply to distance-education projects. This penultimate section attempts to address this issue, particularly as it affects 'two mode' institutions.

### 8.1 Resource models in campus-based systems

In conventional campus-based systems a very high proportion of total costs is spent on staff salaries and related costs. As a result resource models in conventional institutions are either based on *staff:student ratios* (typically relating staff to a headcount of students but often to a count of student full-time equivalents) or on *instructional workload models* which attempt to relate academic staff numbers to their teaching workload.

Those working in 'two mode' institutions which use a staff:student ratio model may attempt to weight students in some way. It is quite common to make use of the notion of a *full-time equivalent* student *(FTES)* in which a regular full-time campus based student is used as the base (ie, is equivalent to 1.0 FTES ) while part-time distance taught students are weighted arbitrarily as, say, 0.5 FTES. Some institutions weigh part-time students on the basis of student load so that part-time students on one course are weighted say 0.3 FTES while another may be weighted 0.9 FTES. In some cases students are weighted differently depending on their subject area, so that a full-time student on a physics course, for example, may be weighted 1.8 FTES and a part time student 0.9 FTES, but students on a literature course would be weighted 1.0 and 0.5 respectively. Also postgraduates may be weighted higher than undergraduates. Practice varies enormously. Griew (1980, p. 81) has argued that while weighting may make explicit the largely hidden assumptions about the *internal* allocation of resources, the summation of the weighted FTES should be equivalent to the actual headcount of students used by government to determine grant.

Instructional workload models (see for example Sheehan and Gulko, 1976) make the fundamental variables affecting costs - notably tutor-student contact hours, average lecturer's teaching load, average class size, explicit. They have been adapted to measure the teaching load involved in distance programmes and compare this with the teaching load in conventional campus-based systems (see section 8.4, subsection b).

## 8.2 Economic models of distance-education systems

Most of the research to date on the cost structure of distance education has concentrated on the development of general economic models which have attempted to identify and explain the behaviour of costs in respect of the fundamental variables - particularly the number of courses and the number of students - in distance teaching systems.

One of the first such models was developed by staff at the British Open University and reported by Wagner (1977). This identified only two variables, courses and students (here and elsewhere within this section the actual symbolism used by original authors has been changed to provide greater internal consistency within this document):

$$T = c\beta + s\partial + f \qquad \textit{[Equation 1]}$$

where:

T = the total cost
c = the number of courses in 'development' weighted as 1.0, plus the number of courses 'in presentation' weighted as 0.1 of a course in development.
s = the number of students
f = the total fixed overhead cost
$\beta$ = the average cost per course
$\partial$ = the average cost per student

This basic model was improved on by Snowden and Daniel (1980) who analysed the costs of the Canadian distance-teaching Athabasca University. They made explicit the distinction between courses in development and courses in presentation:

$$T = c_1\beta_1 + c_2\beta_2 + s\partial + f \qquad \textit{[Equation 2]}$$

where:

$T$ = the total cost
$c_1$ = the number of courses in development
$c_2$ = the number of courses in presentation
$s$ = the number of students (weighted course enrolments)
$\beta_1$ = the average cost of a course in development
$\beta_2$ = the average cost of a course in respect of revision, maintenance and replacement
$\partial$ = the average delivery cost per student (weighted course enrolment)
$f$ = institutional overhead costs (fixed)

and where:

$$c_2 = c_1/y$$

where:

$y$ = the life of the course in years

such that, by substitution,

$$T = \beta_1(c_1 + c_2/y) + s\partial + f \qquad \textit{[Equation 3]}$$

Snowden and Daniel also argued that in a young institution it was unreasonable to expect overhead costs to be fixed and they accordingly modified their formula to take account of the fact that overhead costs would increase during the development phase and they made allowance for this in a further equation.

Further models of this kind were developed by Rumble (1981, 1982a) in respect of the distance-teaching Universidad Estatal a Distancia in Costa Rica and the Universidad Nacional Abierta in Venezuela, and by Guiton (1982) in respect of the distance-teaching systems of small 'two mode' institutions in Australia.

Rumble (1982b) has drawn attention to some of the problems of using formulae such as the above particularly where institutions are subject to reductions in funding. Moreover, while such models are useful in as much as they focus on the major cost-inducing variables and can, within limits, help in decision making at the macro-level, they 'do not specify the fundamental variables, which affect costs, in sufficient detail to be of practical value to people who are trying to prepare an operating budget for an institution' (Rumble, Neil and Tout, 1981, p. 235). This conclusion led Rumble, Neil and Tout to prepare a series of cost functions which would specify in greater detail the fundamental variables affecting costs in respect of the development of course materials and the provision of support services to students (ibid., pp. 250-70). While this is useful one must bear in mind that such formulae are abstractions which can be rendered useless by changing circumstances - for example, the introduction of new technology. Nevertheless the economic models discussed above have some importance precisely because they are simple to understand and can therefore be readily explained to politicians.

## 8.3 Production rates and staffing levels for course and media development and production

Academic and production staff time is an important element in the cost of developing and producing courses and media. A production-rate approach can establish the amount of staff time needed to prepare and produce the learning materials and hence the staff costs likely to be involved. Where courses are of a standard format it may be enough to establish the total amount of time of each class of employee required to develop and produce a course, and the average salary of each category, and then multiply the result by the number of courses in development and production. However, where courses differ widely in their use of media then it is necessary to establish production rates for each media. This is the kind of approach taken by Rumble, Neil and Tout (1981, pp. 257-61).

A production rate is derived by measuring the output of whole courses or of individual components and dividing this by the number of staff years of each category of staff involved, taking into account other duties, prolonged absences such as sick leave or maternity leave, etc. For example, assume that a particular institution has 67 full-time academic staff employed for 365 days each year. Weekends (104 days), public holidays (10 days), holiday entitlement (30 days) and research leave (20 days) account for a total of 164 days. In addition staff are expected to spend some time on administration (allowance 10 days). This leaves 191 'productive days' or 52.3% of an academic's year which can be spent on course development, teaching and research. (Note that this is quite high: the maximum 'productive time' for any category of staff would be about 63%). Changes in terms and conditions of service can be monitored and will show whether the assumptions built into the model remain valid.

Now assume that the staff have no teaching duties and are employed full-time to develop distance courses. One can then measure the output of standard courses or of particular components and derive a production rate for staff wholly employed in the development and production of distance materials and courses. For example, assume that the 67 staff developed 11 standard courses, then the production rate per academic member of staff of standard courses would be 11 ÷ 67 = 0.16 per annum. Alternatively assuming that 325 hours of television or video programming is produced, then the production rate would be 325 ÷ 67 = 4.9 programmes hours per annum.

Production rates can also be determined for the essential work of maintaining courses which are in presentation (eg. writing new examination papers, de-bugging texts where these are shown to have problems, etc). Generally it will not be necessary to determine production rates for the maintenance of particular components.

The essential formula is:

$$p = X/N$$

where:

p = the production rate

X = the product of output (be it a course of a standard type or a component of a course) which is being developed, produced or maintained.

N = the number of staff of category N involved in the activity of developing, producing or maintaining product X

and where by extension:

$$N = X/p$$

The cost of the staff required is then found by multiplying N by the average salary plus other employer costs for that category of staff, as follows:

$$N\Delta$$

where $\Delta$ is the average cost of the staff category.

Production rates can be established for the various categories of staff (academic course writers, editors, broadcast producers, designers, course coordinators, educational technologists, secretaries, etc) in respect of whole courses or particular components (print, audio, video, etc). One can think of this in terms of a matrix where on the horizontal axis one plots the various media $X_1$ (which may be print), $X_2$ (audio cassettes), $X_3$ (video programmes), ... $X_n$ (the final component one is interested in), and on the vertical axis the various categories of staff $N_1$ (academic course writers), $N_2$ (editors), $N_3$ (designers), $N_4$ (video producers) ... $N_n$ (the final category of interest to one). This would provide one with a series of production rates:

| | $X_1$ | $X_2$ | $X_3$ | ... | $X_n$ |
|---|---|---|---|---|---|
| $N_1$ | $p_{X1N1}$ | $p_{X2N1}$ | $p_{X3N1}$ | ... | $p_{XnN1}$ |
| $N_2$ | $p_{X1N2}$ | $p_{X2N2}$ | $p_{X3N2}$ | ... | $p_{XnN2}$ |
| ... | ... | ... | ... | ... | ... |
| $N_n$ | $p_{X1Nn}$ | $p_{X2Nn}$ | $p_{X3Nn}$ | ... | $p_{XnNn}$ |

where $p_{X1N1}$ is the production rate for staff category $N_1$ producing component category $X_1$. Institutional agreement would need to be reached on whether or not the historical production rates (if they are derived from past data) or the assumed production rates (if they are based on estimates) are reasonable or not.

The next step would be to use the agreed production rates against target output levels to establish staffing requirements for each category of staff. The total requirement for staff of category $N_1$ would be:

$$N_1 = [X_1/p_{X1N1}] + [X_2/p_{X2N1}] + ... + [X_n/p_{XnN1}]$$

*[Equation 4]*

and this would be repeated for other categories of staff.

**Example: Equation 4**

The example which follows shows how the academic staff numbers required to support a particular programme of activity can be derived using production rates for various media. If $N_1$ is the number of academic staff and the volume of printed materials to be produced ($X_1$) is 320 course books of a standard length, the volume of audio-cassettes of one hour duration ($X_2$) is 200, the volume of video-cassettes ($X_n$) is 100 programmes of one hour duration, the production rate $p_{X1N1}$, $p_{X2N1}$, $p_{XnN1}$ for print, audio-cassettes and video-cassettes of the kind described is 5, 30 and 7 per annum respectively, then:

$$N_1 = (320 \div 5) + (200 \div 30) + (100 \div 7) = 84.94$$

Note that while we have been talking about the number of academic staff required, this is related to the input of staff time over a given period and not necessarily to the number of staff in post. Thus the output in the example given above could be achieved by 85 people over one year, or by 42.5 people working over two years.

The salary cost of staff would be:

$$N_1\Delta_1 + N_2\Delta_2 + ... + N_n\Delta_n$$

where $\Delta_1$ is the average cost of employing staff in category $N_1$

## 8.4 Workload remission in 'two mode' institutions

In institutions that teach both at a distance and by conventional means and in which staff are expected to undertake duties across both modes, a major problem faced by those planning the allocation of staff time is to establish some kind of equivalency between the workloads imposed on those developing distance materials, those teaching on-campus students, and those tutoring distance students. In this section we look at one way in which this problem might be solved.

### (a) Course teaching in campus-based programmes

Let us assume that academic staff working in conventional programmes have the same terms and conditions of service as those working in a distance programme, with the same number of productive days (following our earlier example, 191 days) and the same number of days available for teaching (134 days). Let us further assume that a full teaching load is defined as a teaching load of 15 hours per week during term time and that this is defined as the *standard lecturer load*.

The *average lecturer load* (defined as the average hours taught by a full time equivalent lecturer) can be determined easily using the Instructional Workload Model which is based on the formula

$$T = (S \times ASH) \div (ACS \times ALH)$$ *[Equation 5]*

where:

T = the number of full-time equivalent lecturers determined by dividing the total class contact hours of staff by the average class contact hours of full-time staff

S = the number of full-time equivalent students, determined by dividing the total student taught hours by the average student taught hours (ASH) of full-time students in the same subject area.

ASH = the average taught hours of a FTE student which is obtained by dividing the total student hours by the number of FTE students.

ACS = the average class size determined by dividing the total student contact hours by the total lecturer hours.

ALH = the average lecturer hours taught by a FTE lecturer, determined by dividing the total lecturer hours by the number of FTE lecturers.

In practice there are a number of ways of deriving the variables S, T, ASH, ACS and ALH (see Sheehan and Gulko, 1976).

The Instructional Workload Model is extremely flexible and can be used not only to determine the size of the teaching establishment (T) but by extension (a) the student:staff ratio (SSR) where:

$$SSR = S \div T = (ACS \times ALH) \div ASH$$

(b) the average class size (ACS):

$$ACS = (S \times ASH) \div (T \times ALH)$$

and (c) average lecturer hours (ALH)

$$ALH = (S \times ASH) \div (T \times ACS)$$

**Example: Instructional Workload Model**

(a) Basic data

The table below provides basic data on seven course a to g including information on the number of students (column 2) and the student hours on each course (column 3). Column 4 provides data on the total number of student taught hours on each course. This is obtained by multiplying the data in column 2 by that in column 3. The number of FTE students is given in column 5 and is equivalent to the student taught hours (column 4) divided by 200 (the full-time load per student). Column 7 provides data on the total lecturer hours required to teach each course.

| 1<br>Course | 2<br>Student numbers | 3<br>Student hours on course | 4<br>Student contact hours (SH) [col 2 x 3] | 5<br>FTE student [col 4 ÷ 200] | 6<br>Total lecturer hours (LH) |
|---|---|---|---|---|---|
| a | 133 | 50 | 6650 | 33.25 | 350 |
| b | 141 | 100 | 14100 | 70.50 | 800 |
| c | 226 | 50 | 11300 | 56.50 | 700 |
| d | 189 | 50 | 9450 | 42.25 | 500 |
| e | 95 | 100 | 9500 | 47.50 | 500 |
| f | 170 | 50 | 8500 | 42.50 | 500 |
| g | 104 | 50 | 5200 | 26.00 | 250 |
| | | | 64600 | 323.50 | 3600 |

(b) Assumptions:

Average student taught hours of a full-time student is 200 hours.
Number of FTE lecturers is 34.
Each term comprises 10 weeks.

(c) Examples:

ALH = LH ÷ T = 3600 ÷ 34 = 105.88 hours per term = 10.6 hours per week

ASH = SH ÷ S = 64600 ÷ 323.5 = 199.69 hours per term ≈ 20 hours per week

ACS = SH ÷ LH = 64600 ÷ 3600 = 17.94

T = (S x ASH) ÷ (ACS x ALH) = (323.5 x 199.69) ÷ (17.94 x 105.88) = 34

SSR = S ÷ T = 323.5 ÷ 34 = 9.5

SSR = (ACS x ALH) ÷ ASH = (17.94 x 105.88) ÷ 199.69 = 9.5

ALH = (S x ASH) ÷ (T x ACS) = (323.5 x 199.69) ÷ (34 x 17.94) = 105.9 per term ≈ 10.6 per week.

### (b) Course development and production in distance programmes

The approach outlined in section 8.3 shows how the overall staffing requirements for course development, production and maintenance can be established using a production rates approach. Section 8.4 (a) shows how the Instructional Workload Model can be used to determine the average lecturer load (ALH) in a conventional class-based teaching programme. In both cases the assumption was that the staff were wholly involved in either producing materials or in teaching.

We can establish an equivalency between the overall load in the distance programme and in the campus based programme by equating the full-time loads for various activities (eg. a full-time load is equivalent to either producing five 64 page books or 30 audio-cassettes or a teaching load of 15 hours per week in the conventional programme). This allows us to determine a full-time load for an individual member of staff working on two programmes: for example, the development of two books would account for 2 ÷ 5 = 0.4 of the staff member's time, while a teaching load of 9 hours would account for 9 ÷ 15 = 0.6 of his or her time.

### (c) Course tuition in distance programmes

Birch and his colleagues have adapted the instructional workload model to meet the needs of distance and fleximode type programmes teaching off-campus students in Britain. Their approach stemmed from the fact that instructional workload models as used in British further education colleges were geared to the staffing implications of teaching loads arising from conventional timetabled classes and laboratories and did not adequately meet the staffing needs arising from the tutoring of part-time students in non-conventional 'open learning' programmes.

Their starting point was to note that lecturers in conventional colleges are required to spend a minimum number of hours per week in college, of which a proportion is to be spent in front of a class (in UK colleges 30 hours and 20 hours respectively). The balance of the time (10 hours) is spent on preparation, marking, administration, etc. However, where teaching patterns emerge which require the lecturer to spend more than the normal amount of time on preparation and marking, as happens in distance-learning situations, and less on face-to-face contact, there has to be a way of negotiating an appropriate reduction of class-contact hours.

They accordingly adapted the instructional workload model approach to provide an estimation of the number of staff required to support distance learners (Birch and Latcham, 1980; Birch and Cuthbert, 1981, pp. 53-5; Birch and Cuthbert, 1982, pp. 103-6).

The essential requirement is to establish a notional load for distance students which can in some way be equated with the load imposed on academic staff by conventional teaching requirements. For example, it might be established that the correspondence and telephone tuition, and other contact with the individual distance student outside the *class* situation, is equivalent to 30 minutes per student, that the average distance student load per academic is 20, and that each group of 20 distance students has one hour of face-to-face contact per fortnight over a ten week term. The total teaching commitment for a member of staff with a group of 20 distance students would be (0.5 hours x 20 students x 10 weeks) + (1 hour x 5 sessions) = 105 hours or 10.5 hours per week. If the normal load in the conventional programme was 15 hours, then the load imposed by a group of 20 distance students would be equivalent to 10.5 ÷ 15 = 0.7 of a conventional load. Thus an equivalency would be established which could be used to assess the individual teaching loads of members of staff and also relate them to course development and maintenance duties.

It is worth pointing out that the same approach applies to the various elements in conventional programmes where the workload arising from teaching a class-based course, supervising the work of sandwich students on industrial work experience, and supervising postgraduate students, needs to be assessed and related to the total load placed on an individual member of staff.

The teaching load arising from tutoring a distance course might be established as follows:

$$(S\ d\ œ) + [(S / g)\ t] \qquad \textit{[Equation 6]}$$

where:

S = the number of student courses on the course
d = the number of weeks the course is taught
œ = the number of hours or the proportion of an hour which is allowed for contact with an individual

distance student for purposes of correspondence tuition etc.

g = the average size of a tutorial group

t = the number of hours tutoring provided on the course

**Example: Equation 6**

Assume that there are 62 students (S) on a course taught over 10 weeks (d); that the allowance for correspondence tuition is 30 minutes per student (i.e. œ = 0.5 hours), the average group size (g) is 20 and there are 5 tutorials (t) during the term. Then the total teaching load over the term is:

$$(62 \times 10 \times 0.5) + [(62 \div 20) \times 5]$$
$$= 310 + (\text{say } 3 \times 5)$$
$$= 325 \text{ hours}$$

The average weekly load is then:

$$\{(S\ d\ œ) + [(S / g)\ t]\} / d \qquad \textit{[Equation 7]}$$
$$= 325 \div 10$$
$$= 32.5$$

If the full-time load (å) is defined as being equivalent to 15 hours per week then the total staffing requirement (N'') to tutor a distance course will be:

$$N'' = \{(S\ d\ œ) + [(S/g)\ t]\} / (d\ å) \qquad \textit{[Equation 8]}$$
$$= 2.17$$

## 8.5 A recommended approach to the development of cost functions for 'two mode' institutions

The development of cost functions for 'two mode' (distance and conventional) educational institutions can best start from the systems approach developed by Kaye and Rumble (see section 3.3). This makes quite explicit the 'front end' approach to the funding of course development and production, and the essential separateness of this subsystem both in time and in function from the teaching and student-support subsystem.

*(a) Development and production of materials and/or courses ('one mode distance-education systems)*

The first sub-element covers the staffing costs incurred in the development and production of the various media X (which we discussed in section 8.3). The second sub-element provides us with the non-staff costs of development and production. This allows us to develop a general cost function for the cost of the production and development of materials or courses (**D**), as follows:

$$\mathbf{D} = [\, N_1\Delta_1 + N_2\Delta_2 + \ldots + N_n\Delta_n \,] + [(ø + ç)_{X1} + (ø + ç)_{X2} + \ldots + (ø + ç)_{Xn} \,]$$

*[Equation 9]*

where:

N = staff in any number of distinct categories 1, 2, ..., n, where the value of any category of N is derived from Equation 4

Δ = the average employment cost of a member of staff in a given category N

ø = the development cost per unit of output for any type of course or component X where the number of courses or components is 1, 2, ..., n

ç = the production cost per unit of output for any component or type of course X where the number of courses or components X *i* is any number 1, 2, ..., n

The non-staff costs of development ø will cover items such as consultancy costs, bought-in editing and design work, and other development costs involved in the production of, for example, prototype teaching materials. A list of possible items is given in Appendix 1. The non-staff costs of production ç cover items (also listed in Appendix 1) such as print fixed costs, copyright clearance, video production etc. Note that where the materials are developed by contracted staff who are paid a consultancy fee, this will be covered in the second element of the cost function.

**Example: Equation 9**

Assume a standard course model $X_1$ which requires 6.4 years of academic staff effort ($N_1$) at an average cost ($\Delta_1$) of £13 000 per year, 5.2 years of broadcast producer effort ($N_2$) at an average cost ($\Delta_2$) of £18 700 per year, and 3.6 years of secretarial effort ($N_3$) at an average cost ($\Delta_3$) of £7200 per year; a development budget (ø) of £15 000 and a production budget (ç) of £47 000; then the total cost is:

$$(6.4 \times 13\,000) + (5.2 \times 18\,700) + (3.6 \times 7200) + 15\,000$$
$$+ 47\,000$$
$$= £268\,360$$

*(b) Maintenance of courses in presentation ('one mode' distance-educatio systems)*

Responsibility for the maintenance of courses and materials will normally be vested in a team of academic and other staff. Such staff will also usually have a budget which they can call upon should the need arise. Courses of different kinds may have different maintenance requirements. The costs of maintenance (**M**) can be reflected fairly easily in a generalised cost function, as follows:

$$\mathbf{M} = [N_1\Delta_1 + \ldots + N_n\Delta_n] + \mu_{X1} + \ldots + \mu_{Xn} \qquad \textit{[Equation 10]}$$

where:

N = staff in any number of discreet categories 1, 2, ..., n where the value of N is determined by use of production rates as shown in Equation 4

Δ = the average employment cost of a member of staff in category N

$\mu$ = a standard budget for maintenance for any course or component X where the number of such courses or components is 1, 2, ..., n

*(c) Course and materials presentation*

A cost function for the presentation of courses or materials needs to take account of five sub-elements - the costs of delivery of the various media, storage of media, tuition or other forms of face-to-face contact, correspondence tuition, and examinations.

Appendix 1 provides details of the various cost elements that may be encountered in a distance-education system. We shall approach each of these sub-elements in turn.

The cost functions outlined below are based on specific assumptions about the relationship of costs to particular activities and volumes. It is important to note that changes in these assumptions will alter the nature of the cost functions themselves (contrast for example the approach to costing correspondence and face-to-face tuition where the staff are internal to the institution and undertake the function as a part of their normal duties [see equation 13] and that taken in equations 14 and 15 where these services are provided by external tutors). None of the cost functions are likely to fit specific circumstances but all them are 'idealised' in the sense that to a greater or lesser extent they reflect the kind of operations that take place in teaching at a distance.

(i) Storage:

The total cost of storage (S) is:

$$S = (X_1 \Omega_1 + \ldots + X_n \Omega_n) + (q_{X1} + \ldots + q_{Xn})$$

*[Equation 11]*

where:

X = the number of components of any particular media X where the number of media X is any number 1, 2, ..., n

$\Omega$ = the variable cost of storage of any component 1, 2, ..., n

q = the fixed cost of storage of any component 1, 2, ..., n

(ii) Delivery including transmission:

The total cost of delivery (**H**) is:

$$\mathbf{H} = (X_1 \partial_1 + ... + X_n \partial_n) + (w_{X1} + ... + w_{Xn})$$

*[Equation 12]*

where:

X = the number of components of any particular media X where the number of media X is any number 1, 2, ..., n

$\partial$ = the average cost of delivery or of transmission of media X

w = the fixed cost of delivering or transmitting media X where the number of media X is any number 1, 2, ..., n

(iii) Correspondence and face-to-face tuition (internal provision)

The staffing requirements for the internal tutoring of distance courses in 'two mode' institutions was established by Equation 8. The cost (**K**) is established simply, as follows:

$$\mathbf{K} = \Delta_{N''} . N''$$

*[Equation 13]*

where:

$\Delta_{N''}$ = the average cost of employment of staff in category $N''$

$N''$ = the academic staff required to tutor distance courses (as derived by Equation 8)

In addition to the staffing costs there may be the costs of the postage incurred in returning corrected assignment papers to the students. The costs of sending out the original question papers may well be absorbed in the costs of mailing course materials to students.

(iv) Correspondence tuition (external)

In institutions where the tutorial function is separated out and done by contracted staff, the cost of correspondence tuition (**A**) may be made up of a number of elements including in respect of tuition on any *one* course:

1. A flat rate fee to the tutor per group of students (including an element for general expenses):

$$\text{Flat rate fee} = (s/l)y$$

where:

- s = the number of student courses on course $c_i$
- l = the standard tutorial load per correspondence tutor
- y = the standard flat rate fee (including an element for expenses)

2. A marking fee per assignment submitted where the total payment to the tutor will be:

$$s(a\,r)\,z$$

where:

- s = the number of students on the course
- a = the number of assignments to be submitted
- r = the rate of return of assignments
- z = the rate of payment per assignment (including an element for postage expenses)

The total cost of tuition (**A**) for all courses $c_1, c_2, ..., c_n$ would be:

$$\mathbf{A} = y\,\{(s/l)_{C1} + ... + (s/l)_{Cn}\} + z\,\{s\,(a\,r)_{C1} + ... + s\,(a\,r)_{Cn}\}$$

*[Equation 14]*

(v) Face-to-face tuition (external):

The cost of face-to-face tuition (F) can be expressed by an adapted instructional workload model (see Equation 8 above) or it may reflect piece-work payments to 'external' tutors. In the latter case the cost can be expressed fairly simply for any course:

$$h\,\{(s/g)\,t\}$$

where:

h = cost per tutor hour
c = the number of courses where this is any number 1, 2, ..., n
s = the number of students on a course
g = the average size of a tutorial group
t = the number of hours of tutoring in groups on a course

and for all courses $c_1 ... c_n$:

$$F = h\;[\;[(s/g)t]_{C1} + ... + [(s/g)t]_{Cn}\;]$$ *[Equation 15]*

(vi) Examinations

The cost of running examinations (E) can be expressed as follows:

$$E = kb + mev + \Psi\;\{(js_{C1}) + ... + (js_{Cn})\}$$

*[Equation 16]*

where:

k = the number of centres at which examinations are held
b = the average cost of hiring an examination centre
m = the number of invigilators per examination
e = the number of examinations scheduled to take place
v = the fee per invigilator
c = the number of courses $c_1 \dots c_n$
s = the number of students on a course
j = the examination sitting rate
¥ = the fee for marking an examination script

The cost of setting examinations may be treated as part of the maintenance costs of the course, while the costs of printing the papers can be treated as an annual production cost within the print budget.

*(e)* Overhead costs

No cost function is proposed for general overheads, largely because it is difficult to be specific in advance as to the particular requirements of individual institutions or to judge in advance the likely structure of such costs. The treatment of overhead costs in 'youthful' distance-teaching systems is discussed in Snowden and Daniel (1980).

## 8.6 A final comment on models

It cannot be stressed enough that the models proposed in section 8 are abstractions which reflect the particular situation described in the text. Models such as these can be used as a basis for planning, but each model will need to be checked and validated against the particular circumstances under which it will be used.