BUILD OR LEASE DECISION PROBLEMS

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This problem which occurs in practice as a managerial option is also the subject of examination questions in Development Economics, and a quick method of assessment would help both the practitioner and the student.

It is of course obvious that there must exist a "break-even" point where the total cost of erecting and running a new building must equal that of the total cost of renting and occupying an existing property. Again it is apparent that where the time required to reach a certain year's purchase factor at a given rate of interest, the formula for the year's purchase factor,

$$\left(y = \frac{(1+r)-1}{r(1+r)^n} \right)$$

must be used to provide another equation.
The formula is a product of the present worth factor

$$\frac{1}{(1+r)^n}$$

multiplied by the Compound Amount per Period factor

$$\frac{(1+r)^n-1}{r},$$

and using this fact the equation can be simplified as shown below:

$$y = \frac{1}{(1+r)^n} \times \frac{(1+r)^n-1}{r}$$

Where
  y = year's purchase factor
  r = rate of interest
  n = period of time (taken in this case as year)

$$\therefore \quad y(1+r)^n = \frac{(1+r)^n-1}{r}$$

and $y \cdot r(1+r)^n = (1+r)^n - 1$
  $y \cdot r(1+r)^n + 1 = (1+r)^n$
dividing both sides by $(1+r)^n$ we get

$$y \cdot r + \frac{1}{(1+r)^n} = 1$$

$$\frac{1}{(1+r)^n} = 1 - y \cdot r$$

$$(1+r)^n = \frac{1}{1-y \cdot r}$$

$$\therefore \quad n = \frac{\log\left(\frac{1}{1-y \cdot r}\right)}{\log(1+r)} \qquad \dots \text{(i)}$$

or written for electronic calculators as

$$n = \log\left(\frac{1}{1-y \cdot r}\right) \cdot \frac{1}{\log(1+r)}$$

The year's purchase factor is also the sum of a geometric progression where both the first term of the series and the common ratio are the present worth factor for one year, and

from this another formula can be derived which is:

$$n = \frac{\log\frac{1}{1+r} - y\left(1 - \frac{1}{1+r}\right)}{\log\frac{1}{1+r}} \qquad \dots \text{(ii)}$$

To use the formula, let us now imagine that the total cost of erecting a new office building (including the site, construction, financing, and all running expenses) amounts to £612 310. The renting of an office with the equivalent area together with the running expenses will be £93,255 per annum, and you wish to know the break-even point assuming the interest rate to be 15%.

The year's purchase is found by dividing £612 310 by £93 255 and is 6·565975, and using this for y and 0·15 for r, and substituting in the equation (i):

$$n = \frac{\log\left(\frac{1}{1-6\cdot565975 \times 0\cdot15}\right)}{\log 1.15}$$

$$= \frac{1\cdot8209152}{0\cdot06069784}$$

$$= 29\cdot999967 \text{ years}$$

To check this figure, you can confirm from the valuation tables, finding the year's purchase factor for 30 years at 15%.
Using the alternative formula (ii) and taking

$$\frac{1}{1+r} = \frac{1}{1\cdot15} \text{ as } 0\cdot869565217, \text{ we get:}$$

$$n = \frac{\log 0\cdot869565217 - 6\cdot565975(1 - 0\cdot869565217)}{\log 0\cdot869565217} - 1$$

$$\frac{\log 0\cdot013133693}{\log 0860565217} - 1$$

$$= 30\cdot99967 - 1$$

$$= 29\cdot99967 \text{ years}$$

Another point of interest is that if the product of the year's purchase, as calculated, multiplied by the discount factor (or the rate of interest) is equal to or more than one, then it would not be economic to build new premises, As an illustration of this if the rate of interest was 16% and not 15% as in the example, 6·565975×0·16 is 1·050556, and so the rented building would be the best option.

Of course we can perceive the maximum rate of return under given conditions from the formula when we consider the limit of $y \cdot r$ to be 1, as the return must be less than $1/y$, or in the example quoted previously this interest rate must be less than 1/6·565978 or 0·15230306, or 15·2300305%. For interest the following break-even points are given

15·1%	33·87056 year
15·2%	44·01998 year
15·21%	46·85313 year
15·22%	51·70624 year
15·23%	92·53934 year
15·23003%	120·52522 year

Checking these figures requires the use of a calculator to find the year's purchase factors. This necessitates going back to first principles and setting the Valuation Tables aside. A paper entitled "The Construction of Valuation Tables Simply Explained" was prepared at the University of Science and Technology, Kumasi, Ghana in March 1977, illustrating the ways in which log tables can be used to obtain valuation factors. A revised and enlarged edition is now being produced specifically for electronic calculators.

Checking one of the above using

$r=15\cdot21\%$ and $n=46\cdot85313$ years we get the year's purchase of $6\cdot565975$ and the other results can be similarly verified.

As an additional example the following answer to a typical examination question is given.

Your advice is required as to whether it would be better to build a new factory or to rent existing premises and the following points and costs are to be taken into consideration.

New Building

	£
Cost of site (including financing)	50 000
Cost of construction (including fees and ditto)	300 000
Rates	10 000 p.a.
Maintenance	7 500 p.a.
Running expenses	14 000 p.a.
Cost of transporting finished articles to wholesalers	4 000 p.a.
Estimated present value of sale of building in 30 years time	5 000

Leased Factory

	£
Rent	35 000 p.a.
Rates	20 000 p.a.
Tenant's maintenance	4 000 p.a.
Running expenses	18 500 p.a.
Cost of transporting finished articles to wholesalers	10 000 p.a.
Total	£87 500 p.a.

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The period to be considered is 30 years, and the new building could be completed at the same time that the existing factory becomes vacant. The cost of moving to either factory would be approximately the same.

The cost of the new building is both in a lump sum and an annual amount. The net capital expenditure is as follows:-

Site	£50 000
Construction costs	£300 000
	£350 000
Less Sale of building, deferred 30 years say	£5 000
	£345 000

The annual costs are:

Rates	£10 000
Maintenance	£7 500
Running Expenses	£14 000
Cost of transporting	£4 000
	£35 500

Deducting the annual charges for the new building from those of the leased building we get a net equivalent annual charge of £52 000. This sum divided into the net capital expenditure gives a year's purchase of $6\cdot634615305$; and a maximum interest rate of $15\cdot07246\%$.

Trying 15%, n (the "break-even" point) is $38\cdot19$ years, or above the 30 year period.

With 14%, the break-even point is 20.17 years, and $14\cdot75\%$, this point become 27.97 years.

Any greater return expected above $14\cdot75\%$ would mean that new development would be uneconomic, and the existing premises should be rented.

Another problem arises if the question is raised as to the rate of interest at a break-even point of say 30 years. An approximate solution could be found by straight line interpolation between $14\cdot75\%$ and 15% as follows:

$$\frac{38\cdot19 - 27\cdot94}{15 - 14.75} = 41 \text{ per percentile point}$$

$$15 - \frac{38\cdot19 - 30}{41} = 14\cdot80024391\%$$

However from the second equation given above expression

$$\frac{1}{(1+r)^{n+1}} - \frac{y+1}{1+r} + y = 0$$

and this can be solved by Newton's method of approximation,

$$a = \frac{f(a)}{f'(a)}$$

or

$$\frac{1}{1+r_1} = \frac{1}{1+r_e} - \frac{\dfrac{1}{(1+r_e)^{n+1}} - \dfrac{y+1}{1+r_e} + y}{(n+1)\dfrac{1}{1+r_e}n - (y+1)}$$

where r_1 is an approximation, and
r_e is the estimated rate of interest.

Using $14\cdot8\%$ as the first estimated figure a result of $14\cdot8348019\%$ is obtained and repeating the calculation using the first result as the estimated rate, $14\cdot834791\%$ is the amount arrived at. The year's purchase for 30 years using $14\cdot834791\%$ as the rate of interest gives a year's purchase figure of $6\cdot634615326$ which is a good check.

With the above equations in mind, a fresh look can be made at all build or lease decision problems, and in making investment or development appraisals.

TECHNICIAN EDUCATION COUNCIL AWARDS

The Institute has now announced that it will accept the Higher Technician Diploma in Building Studies for entry to membership with full exemption from its First Examination, subject to certain provisos. In order to obtain this exemption, holders of the HTD must satisfy the following conditions;

(a) The programme of studies is to contain the undermentioned units at the levels indicated:

    Building Technology V
    Building Services V
    Measurement V
    Site Surveying 111
    Economics of the Industry 1 V
    Building Law 1 V

(b) Each of these units to be obtained as a pass with merit.

(c) The award is to be accompanied by a GCE certificate in English Language at 'O' level grade 'C' or higher.

The acceptance of existing HNC/HND qualifications is not affected by this decision.

Assessment of other TEC awards is continuing in conjunction with a re-appraisal of educational policy and further announcements will be made in due course.