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MEETING THE DEMAND FOR HOUSING
A Model for Establishing Affordability Parameters

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ABSTRACT

This paper introduces and describes the workings of a nomogram to calculate parameters for affordable housing. Whereas affordability models have been available for some time, many of these are computer based, and therefore remain inaccessible to many designers. Moreover, by being computer-based they are not very useful in teaching or demonstrating the relative impact of different variables on affordability, and therefore also of limited use to policy makers.

The affordability model described here uses a series of inter-locked log-log tables to deal with a number of variables simultaneously. The model is proposed here as a tool for making decisions rather than establishing precise values, and is presented as a tool for preliminary analysis and to stimulate thinking about cost and affordability issues.

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Introduction

As world population increases so does the need for housing. Unfortunately, the increasing need for housing is matched only by a growing inability to meet this need. Gradually governments are coming round to accepting the fact that they can not be expected to produce housing in the numbers and at prices that are required without the involvement of the private sector and the community.

One set of responses, advocated by the World Bank for example, is to rely on the market to provide the housing needed[i]. The role of the government would be essentially to remove imperfections in the market and to ensure its smooth operation. Such approaches ignore the fact that public sector intervention was occasioned primarily by the failure of the market to adequately meet housing needs, particularly of the poor. On the other hand, the idea that housing needs can be met through subsidised land, finance or buildings is equally untenable. No country has managed a long term programme of subsidised housing in the face of a growing population.

There is a growing consensus for a support based approach, with the government supporting the housing action and interventions of the community and the private sector through a series of organisational, legislative and other measures. The Global Shelter Strategy[ii] adopted by most countries as part of the Shelter for All by the Year 2000 is largely based around this concept of enablement, of creating conditions whereby households are able to house themselves, without direct government intervention as producers or as subsidiser.

Central to these approaches is the notion of affordability: that the cost of housing that is produced must be equal to or less than the funds available to those for whom it intended. In most developing countries, unless the current levels of one or both of these are radically changed, this means that many, perhaps the majority of households will be unable to afford any "acceptable"[iii] housing. One result of this realisation has been an increasing focus on housing finance and financing mechanisms in order to develop ways of increasing the money available to households. The other is of taking a more innovative look at housing itself, particularly its production and delivery.

In this paper, however, the focus is on affordability itself, and the development of a model that permits an easier definition of parameters that housing designers can utilise to ensure that the housing they produce is affordable by their target group.

We have indicated above that affordability is a situation in which a household has funds that equal

or exceed the price being charged for housing (including land, materials, labour, services, credit and other facilities, fees and charges). Quite clearly affordability is concerned with meeting housing demand rather than with housing needs[iv].

Affordability

In its simplest terms, the affordability equation can be expressed as

funds available price of housing

In the sections that follow we will expand upon these terms and their implication for the design and production of housing, particularly for the poor.

Funds Available

The funds that may be available to a household are of two types: cash and assets that the household currently has or holds and funds that the household could mobilise.

Few households have large amounts of cash to hand, and indeed for most it would be imprudent to do so. For the most part, such funds are likely to be deposited or invested with one or more individual or institution. However, in most of the developing world it is more likely that a household will keep its cash in the form of readily convertible and indeed transportable assets, probably in the form of gold or jewellery. The latter are a more convenient form in which to keep assets both because they are easier to acquire in variable amounts to suit cash availability and to dispose of. In the mean time, they also perform an ornamental or even social function. They do have the disadvantage that keeping large amount may pose a security problem. On the other hand, there are few institutional avenues available or accessible to the poor to deposit their savings without either a physical, logistic or bureaucratic inconvenience which many find unwelcome and off-putting. There are even fewer investment opportunities. Therefore any savings or investment is likely to be with or at least through an intermediary.

In many cases, where households have the intention of acquiring housing, their savings may be in the form of

building and construction materials. In most informal settlements, households have stocks of brick or blocks or timber or other such materials or even plumbing and sanitary goods stockpiled. These are usually bought as and when an opportunity presents itself, either through spare cash or a windfall or a particularly favourable price or availability.

The funds that a household may be able to mobilise are generally through some form of a loan, which may be informal or formal.

Informal Loans

An informal system is one where the rules and regulations defining its operations have not been formally constituted, but are based on custom and practice. As a result, it is also likely to be unofficial and unrecorded, and probably not subject to legal codes. Informal has also been described as being the opposite of formal, or its dual. In practice, the two are not isolated, but are likely to exhibit a high degree of interaction, and probably form a continuum.

Informal loans are usually available to most households either through its network of family, kinship or other social relationships, or through individuals or even organisations that exist mainly or even exclusively for the purpose of advancing money to individuals.

The actual networks that are available to a particular household, and the amount of money that it will be able to borrow, and the terms and conditions that it will have to meet, are of course a function of the particular society and the household's standing and status in it. In most situations, such informal loans are nevertheless `formalised', and the "rules" (regarding who may borrow, from whom, and for what purpose) may be rigidly defined and well known to all members. In other situations, the borrowing may be from a network of friends and even employers rather than relatives and again, be more or less formalised. Often of course, the terms and conditions may be in non-monetary considerations, and indeed the repayment may not be in money either, or to the original lender. Thus, it may be that in return the borrower has to perform other favours, or to return the money at an unspecified time to another member of the network. Although no formal accounting is kept, members of the network and certainly the lender and the borrower will be well aware of their obligations and commitments.

Formal Loans

A formal entity, enterprise, institution or organisation is one that is legally constituted, usually registered and recognised/certified by the public authorities. It has to file reports on its operations and these are usually subject to scrutiny as required by applicable legislation. The formal "sector" consists of all the known and "visible" entities and enterprises, as opposed to the informal "sector" which remains largely "invisible" because it is not subject to regulation, does not file returns and does not appear in official statistics.

A formal loan, in terms of who can borrow, as well as the amount and purpose of the loan, is largely dependent on the lending institutions and organisations that exist, and their operational criteria and conditions. These institutions may be specifically designed to lend money for housing, set up by the government or in the private sector. They will either be using funds allocated to it by the government for lending purposes, or be able to take advantage of government directives to other financial institutions to channel some part of their funds to it. As a private institution, they may still be able to benefit from government directives, or be dependent upon the need of fund managers to keep some of their portfolio in low-risk long term deposits. Alternatively, the institution may be operational in a variety of financial fields, and making loans for housing finance may be one of its many functions.

A number of mutual institutions have also been set up to cater for housing finance needs, such as Savings and Loans Associations, Building Societies and other Co-operative ventures. Again, as well having deposits from their members, they may be able to attract funds because of government directives such as tax incentives designed to direct money to housing.

Ability to borrow

What households can borrow is generally arrived at by using a formula which calculates the capital sum that a regular payment could repay at a given rate of interest, over a fixed time period[v]. If the amount that a borrower is willing and able to devote annually to repaying the loan is expressed as a percentage of his annual income, then it is possible to express the capital sum as a multiple of the borrowers' annual income. There are various programmes and tables that allow for the value of any of these variables to be read off if the others are known.

The nomogram on the next page[vi] uses the intersection of lines of given value to provide values for the dependant variable. As an illustration, the nomogram shows that for a loan of 20 years, at 5% interest, the annual repayment would have to be 8% of the capital borrowed. If a household devotes 24% of its annual income to repayments, it can borrow a capital sum equal to 3 times its annual income.

Ability to Pay

The ability to pay of a household is one of the more critical elements in calculating what a household can borrow, and therefore, of most housing finance strategies, and yet it is the most difficult to be precise

about.

Until the 1980s it was conventional for housing agencies and experts to assume that a household could devote up to 25% of its income to housing repayments, and a figure of 20-25% was thought adequate for making calculations[vii]. The first difficulty arises from being able to define "household income", or even "household", in this context[viii]. Not only are households reluctant to divulge such information, they may actually not know what it is, particularly as for many low income earners it comes from a variety of sources and is irregular. At the same time, questions were raised regarding whose income to take into account: the head of household or also that of other members.

However, other researchers suggested that income figures are in any case misleading, and more reliable

estimates may be obtained from surveys of household expenditure. This led to treating "housing" as a residual (akin to savings), and concluded that households could not afford to devote more than 10% of their income to loan repayments. Indeed, some social surveys of household expenditures showed that households appeared to be regularly spending more than 100% of their stated income on items such as food and other essentials alone (thus further discrediting income figures), therefore leaving no possibility for making housing repayments. Therefore, it has been suggested that while the 20-25% figure is acceptable in general, it is too high for the lower income households, and that the figure for percentage of income that households can afford should be taken as 10%[ix].

However, a 1985 World bank study, using figures from 16 cities in 8 countries[x] shows that the proportion of income devoted to rent decreases with income within cities. Studies of rents paid by low income households show that they may be spending as much as 30% of their incomes, and that this may be higher still in some of the "informal" rental housing which provides few amenities and little space of low quality construction.

On that basis, it could be argued that in developing proposals for housing, it would be safe to assume figures of 30-35% of income being devoted to housing repayments if in return households got not only better housing but also more security, including the possibility of eventual ownership, as well as other facilities and amenities that might reduce or eliminate expenditure on infrastructure services, transport or education.

The ability to pay of a household is of course further complicated if we take time into consideration. Most repayment schemes assume static incomes, whereas in reality, most households expect their incomes to increase over time (in real terms), not only because of an increase in their earnings through promotions etc, but also because they may expect one or more of their children to start earning and contributing to the household's ability to pay. Moreover, once a household has a target, it will undertake a number of saving and income-enhancing related activities that it was not previously doing, in order to meet the target.

We have been talking only about a household's ability to pay. For it to have any economic meaning, in terms of effective demand, we must also take into account the household's *willingness* to pay. In general terms, we can suggest that whereas ability may be a calculatable quantity, willingness is as much conditioned by the quality of what is on offer, and the household's desperation to acquire housing. If the housing on offer is especially attractive in terms of location, value for money, design features, etc., prospective purchasers may make that much more of an effort to find the means to pay for it. Similarly, offering households a choice of options for a given cost level may improve their willingness to pay for housing within their affordability

limits. Equally, a household on the point of eviction, or otherwise desperate for housing, might similarly be willing (or forced) to pay above the odds for housing at that particular time.

Obviously, what a household could do, and whether it *will* do so, cannot be decided by anyone but the household itself. Nor can anyone else but the household take the risk of not succeeding in that effort and thus facing possible hardships in order to meet repayment commitments. This means that only the household can really determine what its ability to pay will be (though we can try and ensure that it both understands what it is committing to and that it has plausible plans for achieving its intentions), and to do that, we need to present the household with a real rather than abstract objective. This means undertaking not so much a survey, but more of a market research, to estimate a household's ability to pay.

The Price of Housing

To a large extent, particularly in a market system, the price of housing will be a function of the cost of housing plus the profits (or losses) the producer or supplier is willing and able to extract. The theory is that in a well-functioning market, excessive profits will attract other producers and suppliers, until competition amongst them brings prices down. Nevertheless, in the short run, it is highly likely that shortages in supply will mean that housing can be a profitable business.

The cost of housing is a function of the costs of the various components that make up housing, and include land, building (materials and labour) infrastructure services, credit, fees and charges.

Land

Land is probably the largest single component in the cost of housing, and is also the major influence on the number of housing units produced. It also endows houses with additional value through its locational attributes. The locational attributes of land determine both the services that are available in close proximity to the site, but may also determine what services can be provided on site, and at what cost. Moreover, since each piece of land is unique, it confers a particular advantage/disadvantage to the housing which may consist of identical units.

Apart from the "opportunity cost" of the land, reflected in its price per unit area, the cost of land is dependent upon the amount or area used for housing. As well as the area of land or plot used for each house, there is also the cost of the land used to provide access and circulation, as well as the land used for public and social services and amenities such as recreation or buffer zones.

However, whether each household is required to pay for the land used for circulation and communal purposes is also a matter of policy. In some situations, it may be possible to recover the cost of land provided for social facilities from the providers of those services. Similarly, municipal authorities may pay for the costs of circulation or other social space out of their own budgets, thus leaving households to pay only for the land occupied by their own housing.

The size of housing plot, and indeed of the land used for related purposes is partly a function of plan- ning rules and regulations as well as social customs and norms. It is also a function of planning and design efficiency. An efficient layout may reduce the total land required by 10 to 20%, and thereby be instrumental in reducing unit housing costs.

Building

The costs of the building, or house itself are also a function of unit costs and total area to be constructed. These may both be a matter of individual taste and preference, but are also likely to be influenced by local building regulations, the design and methods of construction as well as social customs. As well as determining costs by prescribing acceptable or desirable sizes and qualities of construction, these may also prescribe or require the construction of special features (such as water storage tanks or air-raid shelters) regardless of the size and quality of construction of the house.

Infrastructure and Services

As with land and building, the costs of services and infrastructure are dependent upon the level and quality of services and on their quantity[xi]. For any given level of service, the cost of infrastructure provision is directly related to the efficiency of the layout of roads and house plots since most infrastructure is provided through a network of pipes or cables that follow the road and circulation network.

Since most infrastructure runs along the front (or back) of the house plots, the wider the plots, the more the length of pipe required. Ideally, a plot should be between 1:2 and 1:4 to minimise the run of infrastructure network. Similarly, it will be evident that where plots are laid out in such a way as to allow the same length of pipe to serve two houses, their costs will be halved in comparison to layouts that require each plot to be served by its own length of infrastructure. Thus, back-to-back plots, or plots on both sides of an access road will be twice as efficient than if there are plots on only one side of a street. In layout terms, the simple rectilinear grid-iron is probably the most efficient pattern as far as infrastructure layout and therefore costs are concerned[xii].

As well as the costs of on-plot and on-site infrastructure[xiii], there may also be the cost of off-site infrastructure attributable to the total costs of housing. These are infrastructure works that may have to be built or undertaken away from the site, purely in order to service the housing area, and may include such items as transformer stations, pressure reducing or holding cisterns and reservoirs, access roads, bridges etc.

Computing Affordability

From the above discussion it will have become obvious that computing affordability is a complex operation, not only because the various components are difficult to quantify and price, especially in advance of the housing project being designed and laid out. Since the total price is a function of so many components, each of which can vary to accommodate the wide range of possibilities and preferences, the conventional response was to leave the computation of the price till after the housing had been designed, and often, to after it had been constructed.

While this meant that the actual costs that were computed were accurate, it also meant that if it was then found that the houses were unaffordable, it left only two options. One, to subsidise the housing, and the other to change the target group. Often in practice, the former usually resulted in the latter as the lucky allottees traded-in their subsidy for cash.

For limited production by charitable organisations or by the public sector (as it used to operate), this might be an acceptable way of proceeding. For the upper end of the market too, this was a possible process since the end price could always be changed, and if necessary, a different group of buyers found.

However, for the lower end of the market, or for housing targeted at a particular group, this is not an efficient procedure, and a means of design parameters that will result in affordable housing has to be established at the start of the housing process.

Models for Establishing Affordability Parameters

Over the years a number of models have been developed to compute the affordability of housing projects. Most of these were a series of rather cumbersome sets of equations that made the calculations very complex. Until the advent of programmable calculators, the only alternative was to use nomograms that permitted the equations to be solved graphically. Two such nomograms have been widely used, one developed by Nils Jorgensen[xiv] (modified later by Martin Evans) and the other by Ducio Turin (modified by the DPU)[xv]. Jorgensen's nomogram is interesting in that it incorporates the option of progressive interest rate calculations to take into account variable repayment systems and/or inflation. The Turin nomogram introduced the con-cept of fixed and variable housing costs and relating these to size of building. Both of these models were, however, limited in their ability to deal with all the variables, and treated capital costs as one lump sum rather than allowing for an exploration of the impli-cations of changing the physical design parameters.

The Bertaud Model

The first breakthrough came about with the development of the Bertaud Model in 1978. The basic Bertaud Model is now composed of two submodels. The first, known as the Affordability and

Differential Pricing Submodel was designed originally for use on programmable calculators, the HP 67 and the TI 59. In 1984, the affordability programme was translated for use on the IBM PC with the Lotus 1-2-3 spreadsheet programme and on the Apple II Using VisiCalc. This submodel can be used to analyse the relationship between project characteristics and total cost, the affordability of the project to target groups, and its affordability to the executing agency.

The second part of the Bertaud Model, the Detailed Land Use and Infrastructure Costing and Design submodel uses the inputs from the affordability model to produce a site layout. The programme for this submodel has been transcribed for use on IBM and compatible PCs by the Inter-American Development Bank.

The Model was built up on four inter-related equations describing the cost of housing, monthly repayment fraction, plot size and densities. The resulting equation incorporated some 22 inter-dependent variables, ranging from financial terms, costs of infrastructure and construction to plot sizes and ratios and widths of streets and block lengths . The user is asked to select the dependent variable and asked to provide values for the other 21 variables. The computer then works out the value for the dependent variable that would make the project variable.

The model assumes that any lay-out is made up of repeating blocks of houses (varied to suit site conditions), and derives separate equations for some 12 different basic block layouts. The latest versions of the models will not only calculate affordable housing projects but will also calculate and print out an appropriate lay-out on the basis of a digitised site plan being provided[xvi].

The Hudco Model

Working on similar lines and at about the same time as Bertaud, India's Housing and Urban Development Corporation (HUDCO), with assistance provided under USAID, produced a computer programme. HUDCO also produced a set of tables using print-outs from its main-frame computer. These tables provide a set of solutions for the range of values most likely to be encountered in India for housing programmes financed by HUDCO (which funds over 80% of India's public sector programme).

The tables are based on basic planning modules which establish the physical planning framework, including street widths, community facility space etc. For each module there are three options available regarding the amount of social facility space per capita (1.0, 3.0 and 4.5 sq.m) and for each option there are three choices of cluster ratio (length/depth of the module : 1.0,1.5 and 2.0) For each set of options selected, the tables give information such as module width and length, % saleable area, % open space, % circulation space, number of plots etc. It also provides the cost per plot for three different prices of land and three levels of infrastructure provision.

The Shelter Model

As part of the Global Shelter Strategy Programme, the Government of Finland developed a Lotus 123, spreadsheet-based computer model. This model, which was designed to support and supplement the process for developing a shelter strategy[xvii], allows the user to calculate affordable housing on the basis of inputs regarding the basic variables. Interestingly, it also allows the user to choose different mortgage options, and to allow for inflation. The model divides the population into different income groups, and housing into types, distinguishing between rental and owner occupies as well as form of construction. By calculating inputs of materials, labour, land required for each type of housing and making population projections, the model goes on to develop affordable housing programmes, and asks the user to equate the projected requirements of land, materials, manpower and finance to that expected to be available in order to test whether the proposed housing programmes are viable.

Other Models

As well as these models, a number of other models have been developed for calculating housing affordability, either explicitly or as a by-product of making other housing-related calculations. For example, the USAID developed a model for estimating Housing Need which is similar to the SHELTER model in that it relates housing costs to total housing units needed over a given period of time by different groups in the country[xviii]. On the other hand, the ADB model[xix] deals with affordability in passing in their model for developing appropriate and affordable site and services options. Other examples make use of tables or spreadsheets rather than computer models or nomograms, and range from those dealing with a finite or limited range[xx]

The Mumtaz Model

The Bertaud and SHELTER models provide useful tools for computing and testing affordability. Their limitations lie in the fact that despite the rapid spread of personal computers, not everyone has ready access to one. It was in recognition of this that the Tables of the HUDCO model were developed, but they are limited to Indian values, and not only are they not necessarily transferable to other contexts, they are likely to need modification even in India over time as prices and other figures change.

In order to provide a readily available tool which will provide reasonably accurate computations, a nomogram

was devised in 1983, drawing upon developments of the Jorgensen and Turin models. The nomogram consists of six inter-related log-graphs. By plotting given or assumed values for the variables, the values of the dependent variables are arrived at. Since the graphs are inter-related, it is possible to start at nay point or points and work round the graphs in any sequence. Where the results are (socially or otherwise) unacceptable, a process of iteration has to be initiated till an acceptable result is arrived at. Since the calculations are done graphically, it is relatively straightforward to see the direction in which values have to be moved in order to arrive at acceptable results. The model also makes explicit the relationship between the various variables and thus assists in understanding better the ramifications of different decisions that the designer policy maker might be contemplating.

The terminology and parameters used in establishing the principal trade-offs have been kept largely similar to those used by the Bertaud model, thus making it also useful as an explanatory tool for the workings of the Bertaud model and allowing for an easier shift from one to the other.

Since they were originally conceived, a generation of students and practitioners have used the nomograms, and a number of minor modifications have been made as a result of the feed-back from this experience. They have demonstrated their usefulness in providing not just a quick and easy way of establishing affordability parameters, but also in demonstrating the relationships and relative impact of each parameter to students and policy makers and decision takers. In order to make these more generally available to a wider audience, their operation will be explained in greater detail.

Using the Mumtaz Model

In order to derive affordable project parameters we shall be examining each of the main parameters of an urban housing project. Such parameters range from the financial (rate of interest; repayment period) to the physical (open space per capita; level of infrastructure).

The Mumtaz model uses an iterative process to derive affordable values for these parameters. We shall start off by using assumed values for those commonly in use currently for similar projects to derive them. It is not necessary, therefore, at this stage to worry too much about the exact values to use as inputs. (The Appendix gives a description of the parameters, their commonly-used values as well as possible sources for obtaining the values)

The use of the model requires the completion of four tasks. These are described below:

<u>Task 1: Select values and transfer to Nomogram</u>

This task calls for six sets of values, one for each of the inter-related graphs, and may be done in any order. The sequence below is arbitrary.

1a.Planning Standards

Select values for the following and identify them by marking the corresponding lines on Graph A:

-Number of Persons per Plot. Diagonal line in top half of the graph.

-% of Total Sites used for Housing (nett, i.e.
-excluding land used for circulation, open spaces, community facilities and other public uses). Diagonal line, lower half.

-OPTION: It is possible to select a value at this stage for Net Residential Density desired. This option will determine plot size. Alternatively, choose plot size, and density will be determined. Vertical lines, top half.

-Plot Size (See OPTION). Vertical line, bottom half.

1b.Construction and Downpayment

Graph B

-Building costs. Curved line in top half.

-Downpayment (or Savings). Curved lines in bottom half.

1c.Target Group

Graph C

-Cumulative Income distribution curve. Diagonal graph.

-Target Percentile. Equidistant diagonal lines.

-ALTERNATIVE: The intersection of the above two lines will give the income level of the target group. Where the income distribution is not knows, the Income Level can be selected and used instead. Diagonal lines.

1d.Costs

Graph D

-Serviced Land costs/sq. meter. Diagonal lines.

1e.Allocation

Graph E

-House Plot as % of Total Land Paid for. Diagonal

lines.

1f.Financial Terms

Graph F

-Annual interest rate. Curved lines.

-Recovery Period. Vertical lines.

-% income devoted to Housing. Diagonal lines.

Task 2: Derive dependent variables

Having plotted onto the nomograms the values of the independent values (which you have selected), the next task is to use the nomogram to derive the resulting values of the dependent variables. As with the preceding tasks, it does not matter whether you

start with Graph A (Planning standards) or with Graph F (Financial Terms), the result will be the same.

1a.Starting from Graph A

ON GRAPH A:

IF YOU FIXED THE DENSITY (TASK 1A):

Draw a horizontal line through the intersection of the vertical Density line and the diagonal Persons/plot line. Draw a vertical line to pass through the intersection of this horizontal line with the diagonal % of Land for Housing line. This new vertical line will determine the resultant plot size. Extend this vertical line all the way down across Graph D.

IF YOU FIXED THE PLOT SIZE (TASK 1A):

Draw a horizontal line through the intersection of the vertical Plot Size line and the diagonal % of Land for Housing line. Draw a vertical line to pass through the intersection of this horizontal line with the diagonal Persons per Plot line. This new vertical line determines the resulting Density which can be read off in Persons/Hectare on the top scale. Go back to the vertical Plot Size line and extend it all the way down across Graph D.

IN BOTH CASES, ON GRAPH D:

Draw a horizontal line to pass through the intersection of the vertical Plot Size line with the diagonal Serviced Land Cost line. Extend this new horizontal line all the way across Graph E. This line allows you to read off the resultant Capital required/available for Serviced Land per Plot.

Draw a vertical line through the intersection of the horizontal Capital for Serviced Land line with the diagonal House Plot as % of Total Land Paid for line. Extend this line all the way across to the central diagonal line of Graph B. At the top of Graph E the resulting Capital Required/Available for Serviced Land per Household figures can be read off.

ON GRAPH B:

Draw a horizontal line through the intersection of the vertical Capital for Land per Household line, with the curved Down-payment (or Savings) line. Draw a vertical line to pass through the intersection of this new line with the central diagonal (zero) line and extend it till it intersects with the Building Costs line. Draw a horizontal line through this intersection to the edge of Graph C. This gives the

Total Capital Required.

2b.Starting From Graph F:

ON GRAPH F:

Draw a horizontal line through the intersection of the curved Annual interest line with the vertical Repayment Period line. Extend this new vertical line across the graph. At the left hand edge of Graph C, the Annual Payment figure can be read off (expressed as a % of the Capital amount borrowed). Draw a vertical line through the intersection of this horizontal Annual Payment line with the diagonal % Income Devoted to Housing line. Extend this line all the way up across Graph C. This line gives the resultant relationship between Income and Capital borrowable (expressed in Times Income Borrowable).

ON GRAPH C:

IF YOU HAVE DRAWN THE INCOME DISTRIBUTION CURVE:

Draw a diagonal line through the intersection of the new Income Distribution line with the Percentile line. This new diagonal line will indicate the annual income earned by the selected percentile households. A house that cannot be afforded by households with this level of income, will not be affordable by the target group. Draw a horizontal line through the intersection of this income Level diagonal line with the vertical Times Income Borrowable line. This will give the resultant Capital Borrowable per Household, which can be read off along the left edge of Graph C.

IF YOU HAVE SELECTED THE ANNUAL INCOME LEVEL:

Draw a horizontal line through the intersection of the Annual Income Level diagonal line with the vertical Times Income Borrowable line. This will give the resultant Capital Borrowable per Household, which can be read off along the bottom of Graph B.

Task 3: Test for Affordability

Tasks 2a. and b. produced horizontal lines indicating the Capital Required and the Capital Borrowable per Household respectively. Obviously, for the project to be affordable the two values must be the same. If they are, then check to see that the values of the various parameters are acceptable to the households, the lending agency and other bodies involved.

If the values are either unaffordable (the two horizontal lines do not meet), or unacceptable, then the values of the project parameters will have to be altered.

Task 4: Achieving Affordability

In order to improve the values so that the project does become affordable, the values of the first iteration will have to be altered. As a first step, retain the values on Graph F and C (Financial Terms are probably more difficult to alter than construction costs or Planning standards. The Target group should not be altered because then the whole premise of the project alters).

It will be seen that shifting the position of any line (altering the value of any parameter) has an impact on the other lines (values). It is possible to reposition any one line such that the resulting horizontal line in Graph B meets with the horizontal line from Graph C, thus producing an affordable project. However, it is almost certainly going to be a case that this would require such a quantum shift as to be unacceptable. Therefore, in order to achieve affordability, it is likely that a number of lines (values) will have to be changed. A little trail and error will soon indicate the lines that have the greater impact while minimising their acceptability rating.

The Appendix gives an indication of the implication of changing the various parameters.

The final values will no doubt be a compromise between acceptability (or accustomed standards and values) and affordability. If the results seem preposterous, this is a reflection of the values selected given the financial situation of the target population. Remember that if the conventional standards were affordable, there would probably not be a housing shortage. Under some set of values, affordability will be achieved. The question is whether we can be daring and imaginative enough to realise those conditions and accept them.

Dealing with Incremental Housing

One response of housing project planners faced with the discrepancy between affordable and acceptable housing has been to introduce some variant of incremental housing development. This is the method by which most low income households develop acceptable housing by adding to and improving the basic house gradually over time. This is a process that is well worth understanding, incorporating and emulating, provided that the household is not also expected to pay off a housing loan such that takes up all his repayment capacity.

For example, if the proposal is to offer a "sites and services" scheme in order to meet affordability criteria, then the question has to be asked: where will the household find the resources to build the

house if the repayment calculations assume that the households are stretched to the limit of their resources in paying off for the sites and services. To assume that the household's income will increase (unless based on some economically demonstrable reasoning) or even worse, to leave it to wishful thinking and merely hope that the household will somehow find the resources somehow is not advisable. Even worse is the spurious argument that "households understate their incomes" and that therefore there is probably excess capacity that will be mobilised. This makes a nonsense at any attempt to "calculate" affordability.

On the other hand, it is possible to take incremental housing development into account for both housing and infrastructure development, and use it to ensure the adequate provision of land initially. In this case, either the additional future sources of finance for the incremental improvements should be indicated (additional income sources, for example by additional household members taking up income earning activities, or by taking in lodgers or sub-letting), or each of the subsequent stages of the incremental development should take place only after the liabilities for repayments of the loan for the previous stage have been discharged[xxi].

Dealing with Multi-storey Housing

In situations where the costs of housing, particularly of land are so high that only unacceptably small plots are affordable, it is worth considering multi-storey housing. By doubling-up on the plot, the same plot can serve two houses, or effectively halved. By having more stories, the plot can be shared by more houses, thus reducing the land costs for each household. However, keep in mind that as the number of stories increases, the need for open space also increases, reducing the effective land for houses. Doubling the number of stories produces almost double the single story density, but thereafter the impact on densities is much less, and even at 12 floors, the increase in densities is less than 20% more than that produced by two story construction[xxii].

Probably more important than building higher, is the impact of reducing open space on the plot, such as the front and back and especially the at the sides. A two or perhaps three story row- or terrace housing layout will probably produce the most economical housing in terms of land.

As far as the model is concerned, therefore, in multi-story housing schemes, the "plot" area per household can be multiplied by the number of floors to give the size of the plot on the ground.

EXAMPLE

In a recent review of the House Building Finance Corporation (HBFC) of Pakistan, the consultants calculated that using the HBFCs standard 20-year loan at a 15% annual rate of interest, a two-room house costing Rs.38,000 could only be afforded by a small proportion of the population if they devoted 20% of their income to loan repayments.

The consultants examined alternatives in an attempt to extend the loans across a wider range of households and suggested that

-through the use of cheaper building materials, the house cost could be reduced to Rs28,000;

-the plot size could be reduced to 80m² from the current 100m²;

-the housing layouts could be made more efficient, such that the saleable proportion of the land increased to 70% from the current 50%;

-the allocation of land could be altered so that allottees did not pay for circulation, public or other common spaces;

-the allottees be expected to pay a downpayment of Rs.10,000.

As a result of these recommendations, it was suggested that almost twice as many households would be able to borrow from the HBFC. However, the consultants recognised that this would still leave households that would perforce remain outside the HBFCs ambit.

In the nomogram on the following page, the findings and recommendations of the consultants have been plotted, and show that indeed, under the original terms, only some 22% of the population could afford the HBFC loans. If the changes proposed by the consultants are implemented, the number of people that could access the HBFC loans increases, and if all the changes were incorporated, their number is almost doubled, to just over 40%. However, though commendable, it still leaves the majority of the population unable to afford housing.

If it was desired that a mechanism be developed that could provide housing for, say 80% of the population, then a number of more drastic measures would have to evolved. This would involve reducing the cost of building still further, to Rs 13,000 (by providing only one room for example) or increasing the income-capital ratio to 2.2 by expecting households to devote 35% of their incomes to repayment. Alternatively, the plot size could effectively be halved (by adopting a two-story system for example), or by starting off with a lower infrastructure provision initially, or some combination of each of these.

APPENDIX

The notes below give summary descriptions of the parameters and trade-offs handled by the Mumtaz model. They also indicate likely sources of information, commonly used range of values for low-income housing (in brackets), and impact of changing values.

PARAMETER	DESCRIPTION	SOURCE	IMPACT
Number of persons per plot (5-7)	This may be more than just the household members, particularly if it is envisaged that the housing units will be subdivided or second stories built.	From socio-economic data of residential areas housing populations similar to the target group.	Its main impact is on density. Alternations will impact on the plot size. It may be possible to compensate for increasing density by assuming extra incomes.
% of Total Site used for Housing (40-60)	This does not include the areas used for other purposes, but only the housing plot areas themselves.	Planning standards or on the basis of other previous schemes	Alterations will impact mainly on density but also reduce the amount of saleable land.
Net Residential Density	Expressed in persons per hectare.	Planning standards or similar schemes.	Alterations change plot sizes and higher densities will mean lower costs per plot but also possibly higher costs of infrastructure as higher percentages of land being needed for access.
Plot Size (100-200)	In square metres	Planning Standards or similar schemes but it is worth looking at how space is actually used especially in `informal housing' areas to see minimum needs and ways of arriving at them.	Crucial in determining costs to household. However, lower income house-holds use out-door space for living much more than upper income groups, and often use it for income-generation activities as well as living space.
Building Costs	Total costs, including fees and charges of superstructure. If no building is being provided by the project i.e. sites (or core house only) then an allowance must be made for later construction by the household. If households are expected to pay a share of any other construction on the site (schools, clinics, etc), this must be added to this figure.	From contractors of similar housing projects. In the case of allowances for future construction, better information can probably be had from those who are currently in the process of building similar houses in other parts of the city.	This is another crucial element as it constitutes the largest and most visible share of the project from the users point of view. Unfortunately, often by project planners. Higher building costs will mean that less money is available for land or infrastructure.

Downpayment (10-20%)	The amount of `up front' money a house hold needs to have to participate in the project. Expressed in monetary units or as a percentage of the total charges. The precise time by which the money must be paid may vary from that of the first application to when the plot is allocated.	The actual figure or percentage is rather arbitrary. The down-payment acts as a filter to reduce demand, but can also be used to access the likely ability to pay of households, particularly if the downpayment is made up of regular savings instituted in response to the project.	Its main impact is on increasing the total amount available for the project to allocate.
Cumulative Income Distribution	This plots the relationship of the population to income in terms of what percentage of the population earns less than a given amount. Since we are dealing with housing at the lower end of income ranges, it is not too critical what the top 10-30% earn, but the bottom 10-30% is important.	From socio-economic surveys of households. All such figures need to be treated with some caution.	The larger he range of incomes, the more difficult it is going to be to provide a satisfactory solution to those with the lowest incomes.
Target Percentile (60-90)	This indicates which segment of the population is to be targeted by the project	The particular percentile to be targeted is a matter of policy, but by definition, a low-income project must address those in at least the 50th percentile if not lower.	The impact is on determining the income level of targeted households and therefore affecting what funds there are likely to be available.
Income Level	The income level of target households is given by the graph, but where selected as an alternative, the source and impact is the same as that for the above two variables.		
Serviced Land Costs	This is the cost of developed land per square meter. Thus it includes the cost of the land itself, plus any necessary works such as drainage or filling etc, as well as the costs of providing infrastructure (roads, water, sanitation, etc) at the level and	From other comparative schemes.	As a major component of project costs, as costs of serviced land rises, the affordable plot size will reduce.

	standard determined.		
House Plot as % of Total Land Paid For (60-100)	The price that is charged for a plot of land is rarely derived by dividing the total project costs by the total site area to arrive at a per square meter price multiplied by the plot area. This would leave the developer with a loss in respect of all the unsaleable land (open spaces, roadways, etc). Therefore, in order to recover their money, developers will distribute the costs of unsaleable land amongst the plots to arrive at the plot price. In other words, households are expected to pay not just for their own plot of land but also for some proportion of the rest of the site. Alternatively, if there is a cross subsidy involved in a projet, some households will pay for more land than they get by way of plots, while the subsidised households will pay for less land than they get by way of plots. This variable asks for this relationship between plot area to be expressed as a percentage.	The likely value is dependent on policy as well as land use patterns. First, policy will determine how to allocate costs between different land users. Will the households be expected to pay for all the land or will the costs of land used for roads come from a different source? Will the Ministry responsible for education pay for the land used for schools? Of the total land whose costs have to be recovered from households, i still has to be decided whether there will be any cross subsides, particularly if some of the plots are going for use as shop and other non-residential or mixed use.	The higher the percentage Paid figure the more the total price of the plot and therefore the smaller it will have to be in order to become affordable. Plot size will vary directly in proportion to increase in percentage.

Annual Interest Rate (8-12)	This will largely be determined by the rate at which the project financing is made available. Without any subsidies, it will be half a percentage or more higher to reflect administrative costs. Ideally this rate should be the same at which money is commercially available for housing, otherwise the lower rate will reflect a direct subsidy.	From the lending agency, or from the housing or commercial banks.	The higher rate of interest the smaller the total amount available per household an therefore the smaller the affordable plot.
Recovery Period (15-25)	The length of time over which the loan must be repaid.	From lending agency or housing or commercial banks.	A longer repayment period allows for the borrowed amount to be increased, but because of the interest payable, it has diminishing returns.
% Income Devoted To Housing (10-30)	This the share of a households income that is used to pay off the loan.	From household surveys. It is better if this information can be substantiated by the rate of savings, current rent or other such measure rather than on the householders say so.	The larger the share of income devoted to housing, the larger the total loan and therefore the larger the plot.

NOTES

i.Housing - Enabling Markets to Work, A World Bank Policy Paper, The World Bank, Washington, 1993

ii. Global Shelter Strategy, UNCHS Habitat, Nairobi, 1988

iii. As defined by the prevailing legal definitions and standards set for housing in most cities.

iv.**Need**: A need is a requirement or necessity. A need for a product or a service exists whenever the required item is not available or is in short supply. **Housing Need** is a quantification of those households to whom housing is not available. However, "housing" has to be qualified by using standards of acceptability, and "availability" by conditions of supply, and "households" by demography and social change. Consequently, the measurement of housing need becomes complex and more dependent upon definition than on computation. Housing Need is only marginally useful for formulating or establishing housing strategies.

Demand: Demand is the desire of would-be purchasers or users for a particular good or service. Demand is distinguished from need in that the willingness to acquire must be backed up by an ability to acquire. Demand is therefore related to the product's price and varies inversely to it. The demand for a product will be determined also by its desirability or value to the buyer, which may be a function of it's attractiveness or of the degree of desperation and need of the buyer. **Housing Demand** is therefore an estimation of the number of households that would be willing and able to acquire a particular housing solution.

Effective, Potential and **Pent-Up Demand**: Effective demand is that which is actually backed up by a real ability and willingness to purchase a product that is offered. Potential demand is one that may exist in the future or is currently latent, either because the product does not exist, or because there are other conditions that prevent buyers from putting their preferences into action. Pent-up demand is a special case of potential demand, it is current but remains unexpressed largely because of socio-political constraints rather than purely material considerations.

5.The formula is $PMT = C\{i/1-(1+i)^{-n}\}$ where C=capital that may be borrowed; i=annual rate of interest; n=time period of loan in years; and PMT= annual repayment amount.

vi.Wakely, P., Schmetzer, H., and Mumtaz, B., Urban Housing Strategies: Education and Realisation, Pitmans, London, 1976

vii.For example, Orville Grimes found household income devoted to rent to range from 5 to 40%, and suggested that a figure between 15 and 25% be used for calculation purposes (Housing for Low Income Urban Families, John Hopkins Press, Baltimore, 1976), and Nairobi University's Housing Research and Development Unit suggests 15 to 20% as the "norm" (Housing Terminology, HRDU, University of Nairobi, 1978).

viii.We can define *household* as "a group of people who share the same living space *and* regularly contribute to or benefit from one or more household activity or expenditure such as food, rent or utilities. Therefore, *household income* is defined as the sum total of earnings and incomes of all members of the household, minus any amounts that may be retained for the sole use of, or at the exclusive discretion of, one member.

ix.Non-Conventional Financing of Housing for Low-Income Households, United Nations (ST/ESA/83), New York, 1982

x.Malpezzi, S. and Mayo, S. with Gross. D., Housing Demand in Developing Countries, World Bank Staff Working Paper, The World Bank, Washington, 1985

xi.Caminos, H. and Goetherd, R., Urbanisation Primer, MIT Press, Cambridge, 1976

xii.Caminos and Goetherd *op cit*

xiii.On-plot infrastructure is that which is provided for each housing plot for its exclusive use, such as individual water or electricity connections. On-site infrastructure is that which is provided anywhere on the project site, in the form of communal or shared facilities such as stand pipes or toilet blocks or water or sewage pumping stations, step-up or step-down transformers for electricity for a group of houses.

xiv.Jorgensen, N.O., *Housing Finance for Low Income Households,* HRDU, University of Nairobi, Nairobi, 1977

xv.Wakely, Schmetzer and Mumtaz, *op cit*

xvi.The Bertaud Model is available on computer diskettes for IBM and Macintosh computers from the Economic Development Institute, the training wing of the World Bank, at a cost of $50, which includes postage.

xvii.Guidelines for the Development of a Shelter Strategy, UNCHS Habitat, Nairobi, 1988

xviii.Estimating Housing Needs, The Urban Institute for USAID, Washington, 1987

xix.Affordable Low Cost Housing Projects, Kinhill Engineers in association with HFA and CSL, for Asian Development Bank, Manilla, 1991

xx.For example, Ken Wren, in Cities of the Poor, (Ed. Alan Turner), Croon Helm, London 1988, or Urban Projects Manual (Eds. Davidson and Payne), Liverpool University Press for ODA, 1983

xxi.See, for example Mumtaz, B., **Housing Finance that Meets the Needs of the Poor**, mimeo, DPU, London, 1992, for a proposal that is based on incremental housing construction linked to the provision of sequential loans.

xxii.Stevens, P.H.M., Densities in Housing Areas, Tropical Building Studies 1, HMSO, London, 1960