Urban Landuse and Transportation Planning
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Lecture 56
Employment Location Choice and Real Estate Development Location Choice

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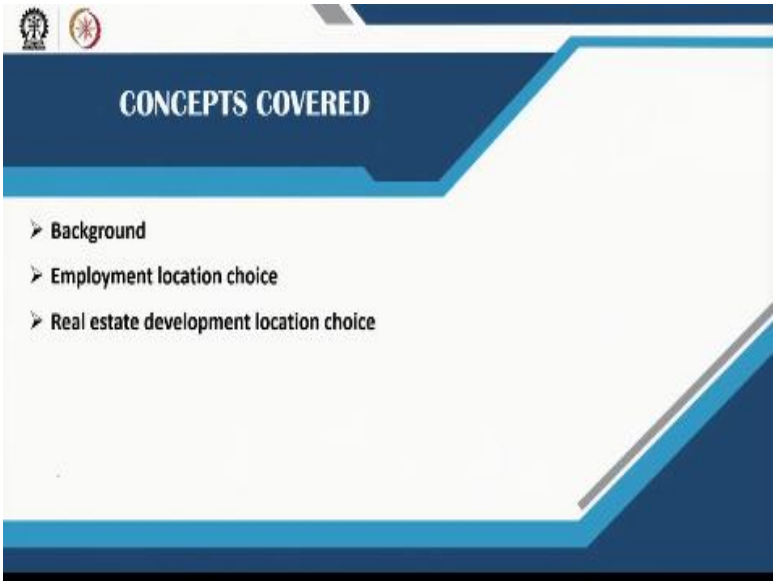

Lecture 56 will cover concepts related to employment location choice model and real estate development location choice model. In earlier lectures, workplace location is considered as exogenous to the residential location choice model, whereas it can be considered as an endogenous variable, which will be discussed in the present lecture.

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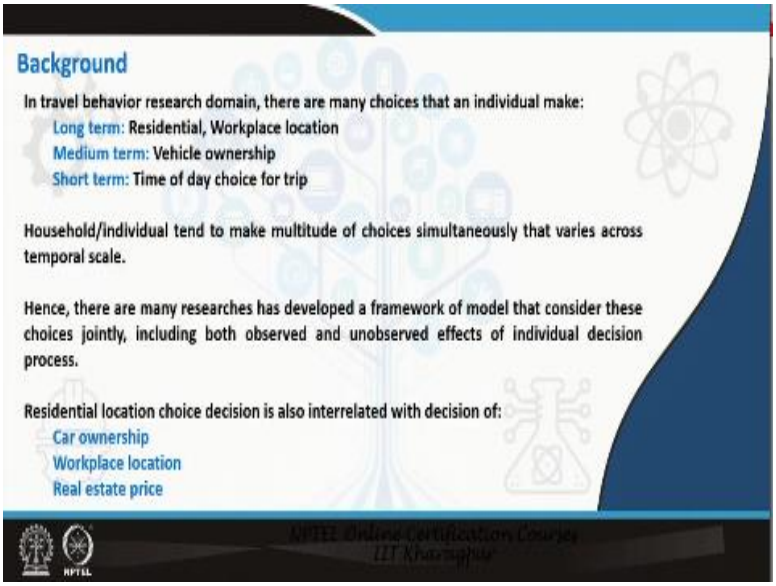

Background

In the domain of travel behavior research, there are many choices that an individual makes. These choices are considered as a part of a decision hierarchy i.e. long term, medium term, and short term choices. Long term choices are not taken frequently such as residential location choice or employment location choice. Medium term choices include vehicle ownership. For instance, an individual buys a car and keep it for 5 years or more. Short term choice can be mode choice, time of the day choice for a particular trip, or if some accident happens on a usual route then the route choice for reaching the destination. So, these are the different kinds of choices that a person makes.

The households and individuals tend to make many choices simultaneously, which varies across time periods as well. Also, many researchers have developed frameworks or models, which consider these choices jointly and includes both observed and unobserved effects of individual decision process. For example, the residential location choice model was jointly developed with the intention to move choice. Similarly, residential location choice could be also jointly thought of with car ownership, workplace location, or real estate prices. So, these are the different choices that can be jointly modeled.

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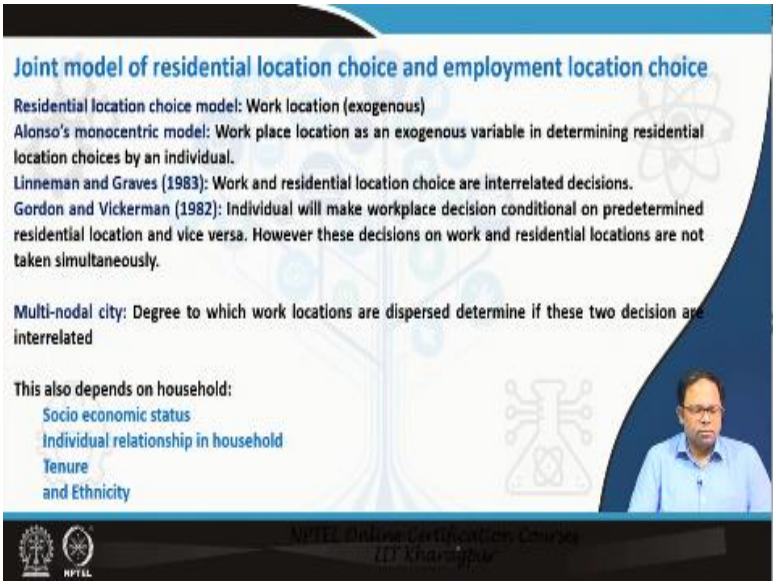

Joint model of residential location choice and employment location choice

In the residential location choice model, workplace location is considered exogenous to the model i.e. the location of the workplace is assumed to be already known to the

analyst/modeler. For example, in Alonso's monocentric model, workplace location was an exogenous variable in determining the residential location choice by an individual.

In 1983, Linneman and Graves argued that, work and residential location choices are interrelated decisions. Also, Gordon and Vickerman (1982) stated that individuals make workplace decisions conditional on predetermined residential location and vice versa. However, these decisions on work and residential locations are not taken simultaneously.

In a multimodal city, where the number of work locations and residential locations are all spread out and intermixed, the interrelationship between both choices is determined by the degree to which work locations are dispersed within the city. It means that if there are lots of job opportunities within an urban area, then people may choose the residential location and work location simultaneously, or their work location may be chosen based on residential location and vice versa. So, the more is the spread; the more is the chance that these decisions are to be taken jointly.

In addition to this, decisions also depend on household characteristics such as socio economic status of the household, individual relationships within the household, ethnicity of the household, and housing tenure.

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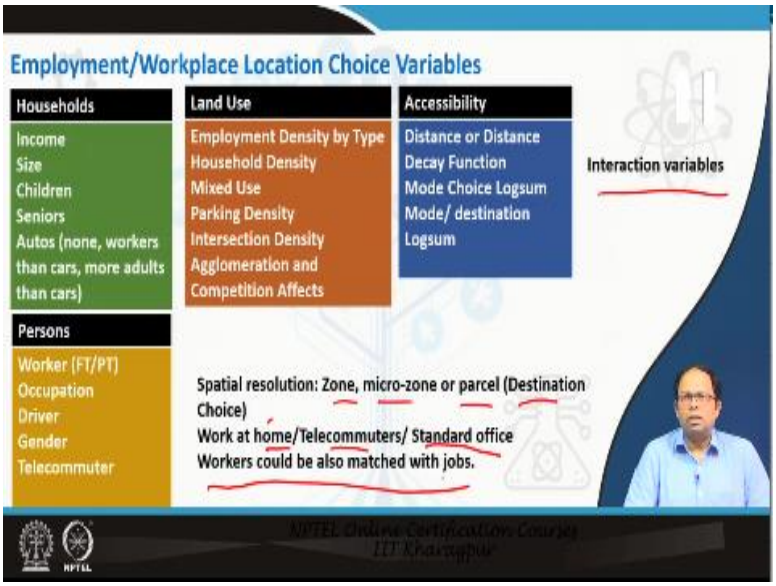

Variables

The variables that can be used in location choice models for employment/workplace location are related to household characteristics, land use characteristics, individual characteristics,

and accessibility. For example, household characteristics include income, size, number of children, number of seniors, and number of automobiles. The number of automobiles could also be defined as no automobiles, or more workers than cars, and more adults than cars.

Person or individual characteristics include characteristics such as worker status i.e. is he working full time or part time, what is his occupation, whether he is a driver, gender, is he a telecommuter or not. Land use characteristics include employment density by type, household density, mixed use i.e. if the area is of mixed use, parking density which decides how many will be able to go there and park their vehicles, intersection density, agglomeration, and competition effects. Agglomeration and competition effects have been discussed in the previous lecture which determines the demand for jobs in a particular area from surrounding zones and so on.

The attributes related to accessibility are distance, or distance decay functions, mode choice log sum, mode/destination choice log sum. Generally, a person chooses a workplace location where accessibility is higher. These are the different ways to include accessibility in the model for workplace location choice. In addition to all these attributes type, there could be interaction variables among all the different terms.

Residential and workplace location choices can be modeled individually or jointly depending on the study context. However, the spatial resolution is considered similar to residential location choice, such as it can be considered at zone level, micro-zone level, or parcel level. Also, workplace/employment location choice can be looked at as a form of a destination choice model, that means where an individual goes for work. In addition to that, it is important to consider if the individual works from home, or the individual is a telecommuter, or goes regularly to a standard office. Accordingly, for each of them, the location choice is determined. If it is work from home, then residential location choice and workplace location choice is the same. If it is telecommuting, then also it influences the decision to choose certain locations. If it is a standard office location, then locations are generally central business districts or an area where there are a lot of commercial offices.

Workplace location choice can be modelled by matching workers with their job types. It means that certain groups of people could only go to certain kinds of jobs. Therefore, location choice alternatives can only be as per the jobs.

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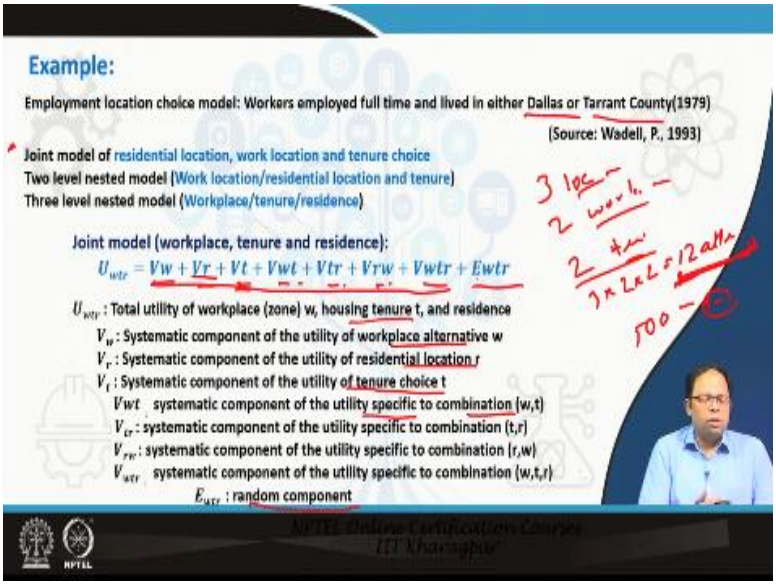

In order to understand the joint modelling of residential location and workplace location, let us consider an example. The present model is developed by Waddell. This is a famous study where employment location choice, residential location choice, and tenure choice are jointly modelled. This was done for workers employed full time and living in either Dallas or Tarrant County in the US.

The model is developed in three ways. In the first one, it is developed as a multinomial logit model, where each alternative represents one workplace location, one residential location, and a tenure type. Also, all the choices are considered at one level. For example, there are 3 residential location choices, 2 work location choices, and 2 tenure choices, then total alternatives are 3 x 2 x 2, which is 12 alternatives. So, if a multinomial logit model is proposed, there could be 12 alternatives or different combinations of residential location, work location, and tenure. The first model is developed in this particular form only.

In a big city, this kind of model is very difficult to estimate due to a large number of alternatives. For example, there could be 500 TAZs for residential location, 300 TAZs for workplace location which are mixed and commercial establishments, and tenure type can be 2 to 3 types. Therefore, the analyst could end up with a huge set of alternatives which becomes difficult to model.

The total utility of workplace w, housing tenure t, and residential location r is partitioned into two components i.e. systematic part and random part, which can be written as:

$$U_{wtr} = V_w + V_t + V_r + V_{wt} + V_{wr} + V_{rt} + V_{wtr} + E_{wtr}$$

Where,

U_{wtr} is the total utility. V_w, V_t, V_r are the systematic utility of workplace w, tenure t, and residential location r respectively. Vwt, Vwr, Vrt, Vwtr are the systematic component of utility specific to combinations or interaction between workplace w and tenure type t, workplace w and residential location r, residential location r and tenure type t, and between all three respectively. Ewtr is the random component or the error term.

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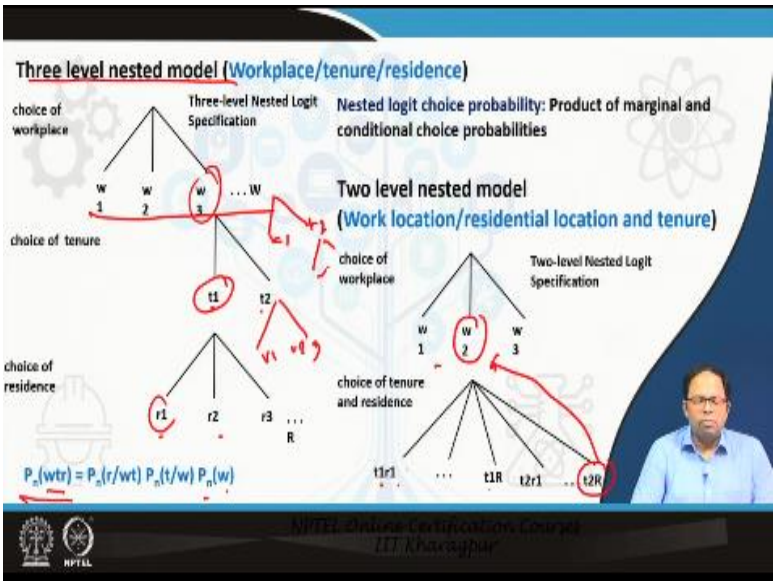

The second model is a three level nested model, where the choice is a three level hierarchy of decision. The first level is associated with workplace location choice, the second level is associated with tenure choice, and the third level is associated with residential location choice. First, the individual chooses a workplace location, then a tenure choice given the workplace location, and then chooses the residential location given choice of workplace and tenure type.

The different workplace locations are w1 to W. For each workplace location, there is a sub-nest of tenure type t1 and t2, and within each sub nest of tenure type, there are residential location choices from r1 to R. For example, a person chooses workplace location w1, he is presented with two tenure type t1 and t2. He selects tenure type t2. For tenure type t2, the

residential location choices are r1, r2, and r3. He selects residential location r2. Then his final choice is w1, t2, and r2.

The nested logit probability of choosing workplace location w, residential location r, and tenure type t can be expressed as the product of conditional and marginal probabilities as follows:

$$P_n(wtr) = P_n\left(\frac{r}{wt}\right) * P_n\left(\frac{t}{w}\right) * P_n(w)$$

Where, $P_n(w)$ is the probability of choosing workplace w, $P_n\left(\frac{t}{w}\right)$ is the conditional probability of choosing tenure t given workplace w, and $P_n\left(\frac{r}{wt}\right)$ is the conditional probability of choosing residence r given tenure t and workplace w.

Similarly, the third form is a two level nested model where the work location choice is considered at the first level, and the second level jointly establish the choice of residential location and tenure type. So, for each work location choice, the residential location and tenure type alternatives are t1r1 to t1R, and t2r1 to t2R.

The first level is a higher level nest, and the second level is a lower level nest. For each of these higher level nest, one can estimate values for the lower level nest which will contribute to the probabilities of the high level nest. So, the joint probability between work and the different tenure and residence type can be estimated.

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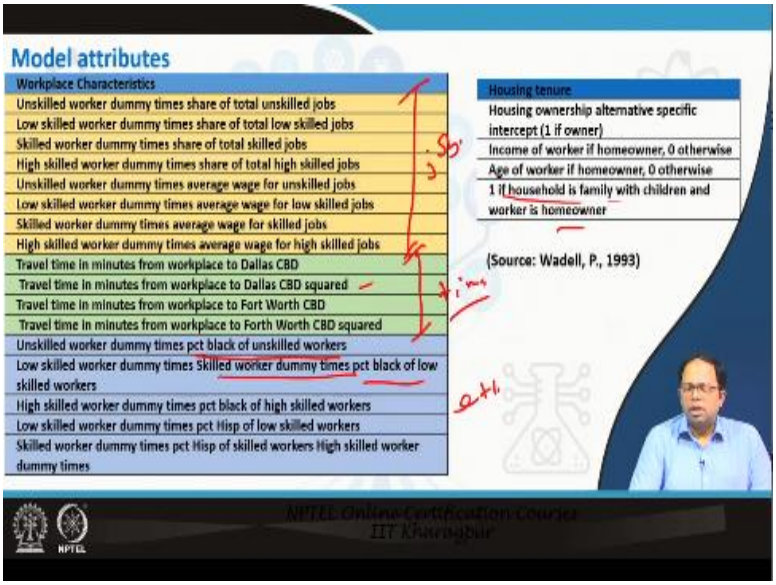

Model attributes

In the present example, several attributes have been considered related to workplace characteristics, residential characteristics, and housing tenure. The workplace and residential location characteristics represent the attractiveness of a particular zone/census tract. The workplace characteristics include travel time related attributes such as travel time in minutes from workplace to CBD, and travel time (in minutes) from workplace to CBD squared. Both the attributes are considered for Dallas and Fort Worth. Square of travel time is taken to increase the effectiveness of the workplace in the model.

In addition to travel time, the other workplace characteristics are related to the job supply of the same job skill type, the average wage for the same job skill type. For example, unskilled workers times the share of total unskilled jobs, low skilled workers times the share of total low skilled jobs, skilled workers times the share of total skilled jobs, high skilled workers times the share of total high skilled jobs, unskilled worker times the average wage for the unskilled jobs, low skilled workers times the average wage for the low skilled jobs and others. Also, demographic characteristics like ethnicity was considered as the percentage of workers who are Black or Hispanic. For example, unskilled workers times the number of black unskilled workers, low skilled workers times the number of Hispanic low skilled workers, and so on.

The next group of variables are interaction terms between homeownership and household characteristics, such as housing ownership alternative specific intercept for this particular

owner, income of worker if household is a homeowner, age of worker if the household is homeowner, and if household is family with children and worker is a homeowner.

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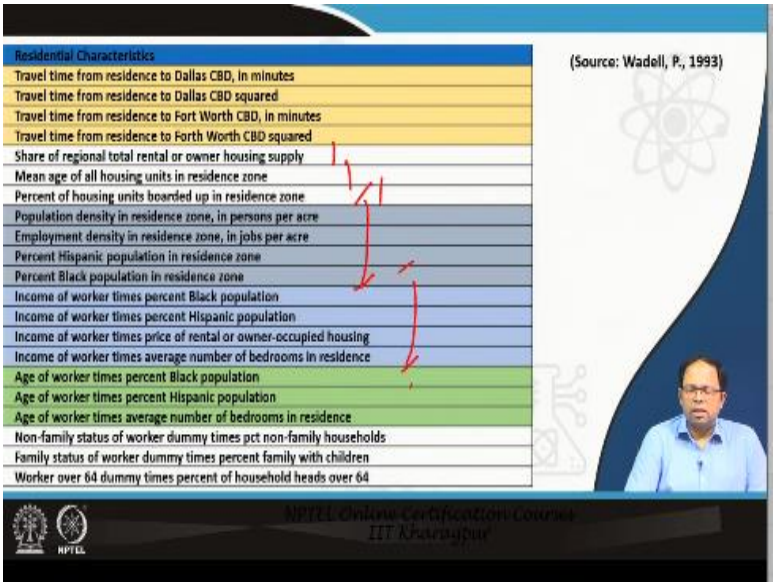

The residential location characteristics include variables related to the distance of the residence from the two CBDs (Dallas and Fort Worth), such as travel time from residence to Dallas CBD in minutes, travel time from residence to Fort Worth CBD in minutes, and the squared value of both the variables. Quantity, age, and substandard housing attributes such as share of regional total rental or owner housing supply, the mean age of all the housing units in a residential zone, and percentage of housing units boarded up in residential zone are also considered in the model. In addition to these, population density, employment density, percentage of Black and Hispanic population are also included.

The author also considered several interaction terms. These interaction terms are related to income and racial composition, income and mean housing price, age and racial composition, age and size of housing, and the percentage of residents in the same stage of life cycle. For example, income of worker times percentage of black population, income of worker times percentage of Hispanic, age of workers times percentage of Black population, age of workers times the average number of bedroom in residence, non-family status of worker times the percentage of non-family households, and so on.

So, these are the different parameters that were used in the model. However, the main idea that comes from this example is that the different decisions can be modelled jointly. It can be

done in different ways such as nested logit model, joint models where different alternatives are considered at one level.

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Real estate development

The real estate development model represents the decision making process concerning investment in the real estate market. This means the decision to buy and invest/ construct real estate, of certain types, in certain locations, by people and developers respectively. A real estate development model determines the kind of supply that can be witnessed in a given area, in forthcoming periods. For example, if a person decides to construct or build a particular real estate, with a given timeline of its own, it would be available in the housing market after a couple of years, only after the construction is done. So, in a simulation process of land use transportation simulation, the real estate development model is one component. Once the realistic locations of real estate in a given area, and the quantum of the development is determined, it becomes a part of the available real estate supply. This can be used as location alternatives for residential location choice in a future time period.

Standard economic theory considers a market to be perfectly competitive. Whereas, the housing market, in reality, violates the assumption of perfect competition. This happens due to the heterogeneous nature of the housing market, the reasons behind which are as follows:

- Quantum of buyers and sellers are low, with their own heterogeneity.
- The attributes of each housing project or property are different.
- The market is segmented into smaller regional/ zonal markets, each of which has its own dynamics and characteristics.

- Government intervention exists in terms of supply; providing subsidies; and price capping for certain types of housing. Macroeconomic environment like; loan rates, etc. also contribute to heterogeneity.
- Imperfect information of people due to the incomplete knowledge about the price and other characteristics of the real estate or housing.
- Barriers to entry from the demand side and supply side.
- The prevalence of buying land and speculating the growth in that area.
- Other local interventions.

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In a real estate market, there are several actors like, real estate companies; small owners who make real estate decisions; management companies of real estate funds who decide to invest in a particular location and fund those companies who construct there, leading to the development of those areas; user-owners; and tenants. Actors operate in different submarkets, which increases the heterogeneity in investment decisions. Each actor chooses a location (E.g.: a real estate company chooses a location for investment) based on perceived attractiveness in that specific submarket. That means the decision choice or location choice or utility maximization is with respect to a particular sub-market only. Generalizing it over other areas may give wrong results.

Residential location choice and real estate development location model are interrelated. Locations should be favorable for investors as well as for households looking for places to settle. That means, whichever areas people feel comfortable to relocate to, or analytically, the

attributes important in a person's residential location choice, are also important for real estate developers or an investor to choose locations for investment. Location choice for investment decisions depends on several location attributes based on economic, environmental, social, institutional context and physical characteristics of that particular area or that particular location, etc.

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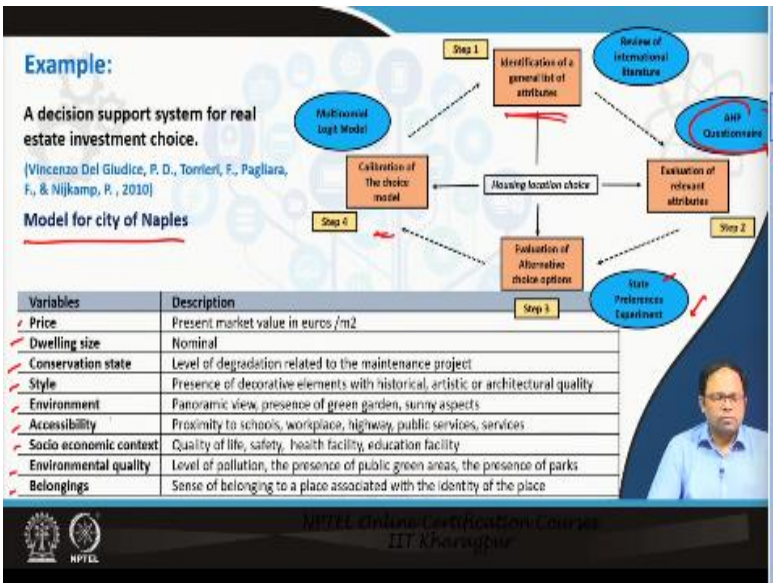

In this particular example, a 4-step decision support system for real estate investment choice by Vincenzo Del Giudice et al. (2010) is presented which was done for the city of Naples. The first step was to identify a general list of attributes or characteristics, from literature, which may play a role in the location choice. The second step was to evaluate the list to determine the relevant and important attributes using the responses of the questionnaire with all the attributes and analyzing them through the analytical hierarchy process (AHP). The different parameters that were considered were, price; present market value in euros per meter square; dwelling size; conservation state; style in terms of the presence of any decorative elements with artistic, historical, architectural quality; the environment in terms of surrounding ambiance; accessibility in terms of proximity to schools, workplaces, highway, public services; socio economic context in terms of quality of life, safety, health; environmental quality in terms of pollution, presence of public green areas and parks; belongings i.e. sense of belonging to a place associated with the identity of the place; etc.

In this process, first, there can be a larger list of parameters that can be subjected to AHP by surveying some real estate developers and asking them about parameters which influence

their investment decisions. Similarly, big companies, real estate funds, smaller companies, etc. can also be surveyed for the AHP exercise. Any other kind of method which determines the importance of those parameters can also be used. After the determination of the relevant factors, a stated choice experiment is conducted. The benefit of reducing the number of attributes can be realized in this step as a choice scenario with many attributes becomes difficult for a person to evaluate and a meaningful choice cannot be made. AHP questionnaire usually reduces the total number of attributes by itself, and they can be further reduced by the analyst if he/she chooses to use only the highest ranked attributes. The result of the stated choice experiment further can also be seen as another attribute reduction step as it estimates the importance, in terms of weights or coefficients, of each attribute in the decision making process.

This method and the list of variables or attributes can be used directly to survey existing housing locations, new housing projects that have come up in the last 5-10 years, and then the characteristics of each of these areas can be compared based on the variables. Statistical models like multinomial logit model, linear regression model, etc. can be used to determine the parameters which have been important for the decision of a company to choose a particular location, or in aggregated scale in each zone to determine the characteristics that influence more investment.

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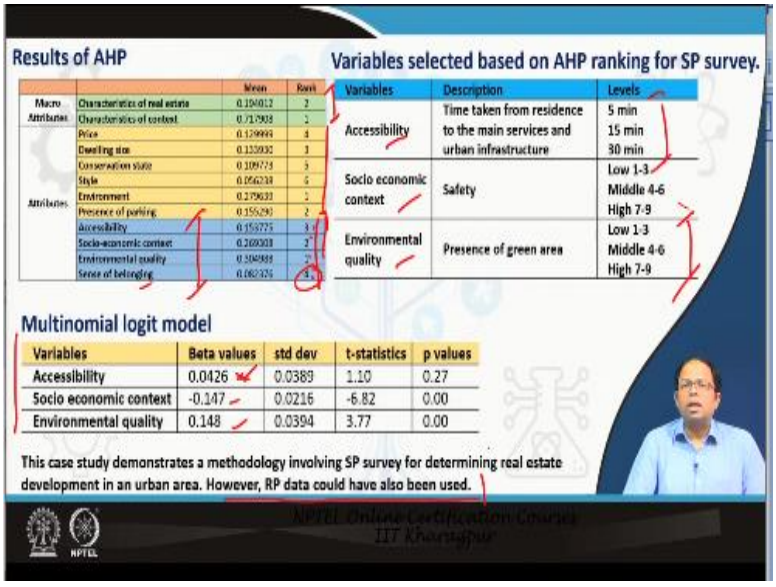

The following table shows the results of AHP from the example, where several attributes are mentioned like, price, dwelling size, conservation state, style, environment, etc.

Results of AHP

		Mean	Rank
Macro Attributes	**Characteristics of real estate**	0.194012	2
	Characteristics of context	0.717908	1
Attributes	**Price**	0.129999	4
	Dwelling size	0.133930	3
	Conservation state	0.109773	5
	Style	0.056238	6
	Environment	0.279639	1
	Presence of parking	0.155290	2
	Accessibility	0.153775	3
	Socio-economic context	0.269308	2
	Environmental quality	0.304988	1
	Sense of belonging	0.082376	4

Based on the responses of the experts to the AHP questionnaire, the attributes are ranked and the top three ranked attributes i.e., accessibility, socio economic contexts, environmental quality, are selected for the stated choice experiment, as mentioned in the table below, with their respective levels for the experiment.

Variables selected for Stated choice experiment.:

Variables	**Description**	**Levels**
Accessibility	**Time taken from residence to the main services and urban infrastructure**	**5 min**; **15 min**; **30 min**
Socio economic context	**Safety**	**Low 1-3**; **Middle 4-6**; **High 7-9**
Environmental quality	**Presence of green area**	**Low 1-3**; **Middle 4-6**; **High 7-9**

The combination of these levels of variables is used to construct hypothetical scenarios that are subjected to evaluation by respondents and the response, in terms of choice is recoded. A multinomial logit model has been used in this case, to estimate the choice model, the results of which are given below.

MNL model using the Stated choice experiment.

Variables	Beta values	std. dev.	t-statistics	p values
Accessibility	0.0426	0.0389	1.10	0.27
Socio economic context	-0.147	0.0216	-6.82	0.00
Environmental quality	0.148	0.0394	3.77	0.00

For accessibility, the positive beta value implies that, the increase in its value increases the total attractiveness or the location choice or probability of the location being selected for investment decisions. Socio economic context i.e. safety has a negative coefficient, implying when safety is reduced then the location choice becomes less attractive. And as environmental quality improves, the location becomes more attractive. Similar methods could be also applied, but this gives us a framework for evaluating location choices in general. When we are looking into location choices for investment decisions, the parameter choice is mostly related to residential location choice, in addition to certain other parameters, which influence investors to invest in a particular location.

Revealed Preference (RP) data can be used as well, in which case, a lot of data regarding the developments that have happened in the last few years and the characteristics that need to be evaluated for each of those developments, needs to be gathered. This is a cumbersome process, but, it may give a broader as well as robust evaluation of each of the parameters which influence investment decision in a particular housing market.

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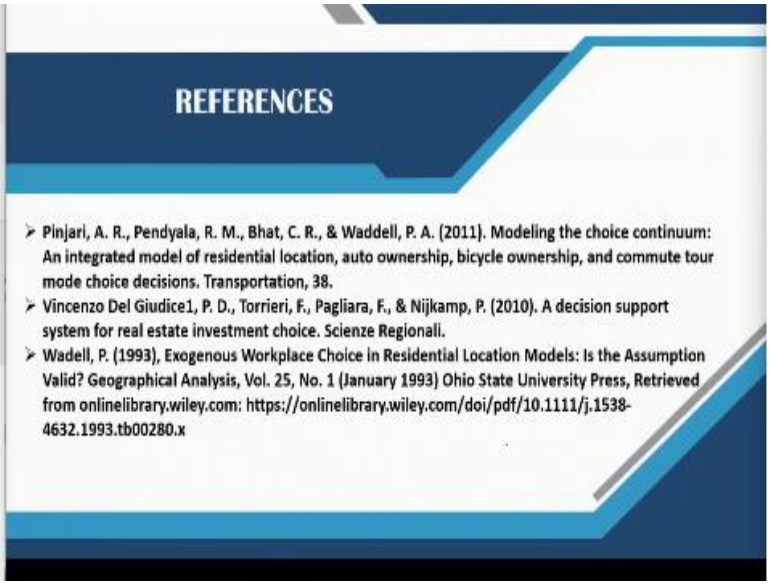

Some of the references are listed in the above slide.

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Conclusion

Employment or workplace location choice and real estate development location choice are intrinsically connected with residential location choice in an urban area. Joint models for employment and residential location choice can be developed as per different employment categories and tenure in the Indian context. For example, for some people workplace location is fixed and residence is chosen whereas, for others, residence is fixed and accordingly workplace is chosen. However, the choice depends on job type, income group, and other factors. Also, there could be separate models for each category of employment or income group.

Real estate development location choice models for an urban area can also be developed from observed choices of development that has happened in an area along with urban growth pattern and trends by exploring the proposed infrastructure, and other development projects. In addition to the existing location choices that has happened, one needs to understand the trends and patterns of growth for the particular area, and also the proposed infrastructure and development projects that will influence the location choice for the real estate development. However, the future real estate redevelopment projects (such as brownfield redevelopment) and particularly commercial projects (new shopping mall) are difficult to predict. Also, these proposals are connected with government policies and demand. For example, policies on redevelopment, what sort of benefits that real estate developers will get, influence the real estate location choices.