



Population Growth P(Population Growth)	Increase (<1%) 0.4	Increase(>=1%) 0.6			
Migration Rate P(MR)	Increase 0.5	Decrease 0.5			
Environment Quality P(EQ)	Safe 0.18	Moderate 0.56	Hazardous 0.26		
Location P(Location)	Congested 0.61	Spacious 0.39			
Neighbourhood P(Neighbourhood)	Safe 0.67	Unsafe 0.33			
Area					
EQ	Location	Neighbourhood	Posh	Poor	
Safe	Congested	Safe	0.73	0.27	
Safe	Congested	Unsafe	0.48	0.52	
Safe	Spacious	Safe	0.95	0.05	
Safe	Spacious	Unsafe	0.6	0.4	
Moderate	Congested	Safe	0.58	0.42	
Moderate	Congested	Unsafe	0.37	0.53	
Moderate	Spacious	Safe	0.67	0.33	
Moderate	Spacious	Unsafe	0.42	0.58	
Hazardous	Congested	Safe	0.3	0.7	
Hazardous	Congested	Unsafe	0.05	0.95	
Hazardous	Spacious	Safe	0.4	0.6	
Hazardous	Spacious	Unsafe	0.35	0.65	
Number of bedrooms P(NoB)	<=2 0.42	>2 0.58			
Terrace Size P(Terrace Size)	<160sqm 0.9	>=160sqm 0.1			
Kitchen Size P(Kitchen Size)	<60sqm 0.67	>=60sqm 0.33			
Garage Size P(Garage Size)	<24sqm 0.8	>=24sqm 0.2			
Front Lot P(Front Lot)	<80sqm 0.84	>=80sqm 0.16			
Inhouse Area					
NoB	Terrace Size	Kitchen Size	Big	Medium	Small
<=2	<160sqm	<60sqm	0.2	0.25	0.55
<=2	<160sqm	>=60sqm	0.25	0.25	0.5
<=2	>=160sqm	<60sqm	0.3	0.25	0.45
<=2	>=160sqm	>=60sqm	0.35	0.3	0.35
>2	<160sqm	<60sqm	0.32	0.3	0.38
>2	<160sqm	>=60sqm	0.4	0.4	0.2
>2	>=160sqm	<60sqm	0.42	0.45	0.13
>2	>=160sqm	>=60sqm	0.8	0.18	0.02
Total Carpet Area					
Inhouse Area	Garage Size	Front Lot	Big	Medium	Small
Big	<24sqm	<80sqm	0.92	0.07	0.01
Big	<24sqm	>=80sqm	0.95	0.05	0
Big	>=24sqm	<80sqm	0.93	0.07	0
Big	>=24sqm	>=80sqm	0.99	0.01	0
Medium	<24sqm	<80sqm	0.05	0.45	0.5
Medium	<24sqm	>=80sqm	0.1	0.56	0.34
Medium	>=24sqm	<80sqm	0.1	0.6	0.3
Medium	>=24sqm	>=80sqm	0.15	0.7	0.15
Small	<24sqm	<80sqm	0.05	0.19	0.76
Small	<24sqm	>=80sqm	0.06	0.24	0.7
Small	>=24sqm	<80sqm	0.05	0.21	0.74
Small	>=24sqm	>=80sqm	0.08	0.24	0.68
Imports P(Imports)	Increase 0.27	Decrease 0.73			
GDP					
Imports	Rate rises	Rate falls			
Increase	0.28	0.72			
Decrease	0.54	0.46			
Interest Rates P(Interest Rates)	Increase 0.24	Decrease 0.76			
Money in market					
GDP	Interest Rate	Increase	Decreases		
Rate rises	Increase	0.37	0.63		
Rate rises	Decrease	0.7	0.3		
Rate falls	Increase	0.6	0.4		
Rate falls	Decrease	0.45	0.55		
Income Growth					
Unemployment Rate	Tax Prices	<6%	>=6%		
Increase	Increase	0.9	0.2		
Increase	Decrease	0.72	0.28		
Decrease	Increase	0.45	0.55		
Decrease	Decrease	0.24	0.76		
Tax Prices P(Tax Prices)	Increase 0.58	Decrease 0.42			
Unemployment Rate P(Unemployment Rate)	Increase 0.23	Decrease 0.77			
Demands					
Migration	Income Growth	Population Growth	Money in market	Rises	Falls
Increase	<6%	<1%	Increase	0.2	0.8
Increase	<6%	<1%	Decrease	0.35	0.65
Increase	<6%	>=1%	Increase	0.42	0.58
Increase	<6%	>=1%	Decrease	0.39	0.61
Increase	>=6%	<1%	Increase	0.46	0.64
Increase	>=6%	<1%	Decrease	0.49	0.51
Increase	>=6%	>=1%	Increase	0.53	0.47
Increase	>=6%	>=1%	Decrease	0.57	0.43
Decrease	<6%	<1%	Increase	0.18	0.82
Decrease	<6%	<1%	Decrease	0.29	0.71
Decrease	<6%	>=1%	Increase	0.33	0.67
Decrease	<6%	>=1%	Decrease	0.3	0.7
Decrease	>=6%	<1%	Increase	0.45	0.55
Decrease	>=6%	<1%	Decrease	0.48	0.52
Decrease	>=6%	>=1%	Increase	0.38	0.62
Decrease	>=6%	>=1%	Decrease	0.67	0.33
Housing Prices					
Total Carpet Area	Area	Demands	High	Medium	Low
Big	Posh	Rises	0.9	0.08	0.02
Big	Posh	Falls	0.74	0.2	0.06
Big	Poor	Rises	0.55	0.3	0.15
Big	Poor	Falls	0.48	0.35	0.17
Medium	Posh	Rises	0.52	0.32	0.16
Medium	Posh	Falls	0.43	0.35	0.22
Medium	Poor	Rises	0.46	0.29	0.25
Medium	Poor	Falls	0.36	0.36	0.28
Small	Posh	Rises	0.3	0.4	0.3
Small	Posh	Falls	0.23	0.4	0.37
Small	Poor	Rises	0.25	0.37	0.48
Small	Poor	Falls	0.17	0.31	0.52

## **Justification:**

Note the below mentioned nodes:

- 1) **Population Growth**
- 2) **Migration Rate**
- 3) **Imports**
- 4) **Interest Rate**
- 5) **Tax Rate**
- 6) **Unemployment Rate**

The above mentioned nodes are the roots. Their probabilities are calculated from real data obtained from <https://tradingeconomics.com/india>. Statistics from over 10 to 50 years are taken and their probability of happening is calculated.

Now consider the below nodes:

- 1) **GDP**
- 2) **Income Growth**
- 3) **Money in the market**

The real statistics for the above node has been collected for the same duration as above and the probabilities are calculated after correlating them with the trends in their parents.

The CSP for **Demands** node has been build up after carefully studying the trends in the money supply in the market, the migration from rural to urban areas, birth rate and death rate as well as the per capita income of the people. These have been correlated with the fluctuating demands for goods and services, especially taking into account the demands for real-estate.

Consider the below nodes:

- 1) **Number of bedrooms**
- 2) **Terrace Size**
- 3) **Kitchen Size**

These are independent factor. The probabilities for the same have been obtained from the household census some 10-15 years back. Though the data is a bit stale, we have tried to inculcate the factor from the present as well.

The CSP for **Inhouse Area** is estimated depending upon the relative sizes of its parent nodes. Also, the real data for the same was taken for support. But, the dependency has been taken into account strongly.

Eg. If NoB $\geq$ 2 and Terrace Size  $\geq$  160sqm and Kitchen Size  $\geq$  60sqm, then it is highly probable of the inhouse area to be big.

In this way, the big, medium and small variables have been distributed with the probabilities with actual data correlated weakly.

The CSP for **Total Carpet Area** has been calculated the same way as the Inhouse area.

The probabilities of **Front Lot** and **Garage Size** were calculated and estimated after reading an article in Time Of India (online). These probabilities were also taken into account after going through a report on trends in real estate available online. We also used our personal knowledge regarding the data and the trends in our cities and some other links available online.

The CSP for **Neighbourhood** and **Location** were estimated after going through the articles in the Hindu and Times about best cities to live in where they highlighted some data about general density of population in a locality and also about the safety standards met in a city, more specifically about Hyderabad and Pune.

The CSP for **Environment Quality** has also been obtained from some data of air index in metropolitan cities which has been weighted with that of medium sized cities and rural areas.

The table for **Housing Prices** depends on Area, Total Carpet Area, Demands.

Out of these, demands is a macro factor affecting a region in particular, say India as a whole. Area weighs the prices for a particular locality in a city or a place. Say, for eg., In Mumbai, houses on Marine Drive and Ghatkopar weigh differently in the market value. Hence, such considerations are looked into before writing the probability. The most important factor of the all is Total Carpet Area. We saw some data where a 2BHK in Kolkata was priced differently with a 4BHK in the same locality and a 2BHK in Delhi and Mumbai. In this practise, we saw around 10-20 such price comparison on house estate websites and then came to conclusive probabilities.

### Pruning of nodes:

We pruned our factors such as Minimum Labour Pay as it was weakly affecting the demands for real estate. We also pruned the recession and investing factor, which we tried to collaborate within interest rate and tax rate factors. We also pruned Air and Road Quality, Noise Pollution, Crime Rate and Traffic, while trying to cover the aspects of the same in locality and neighbourhood and environment quality.

### Query:

$P(\text{Housing Prices} = \text{High} \mid \text{Area} = \text{Posh and Environment Quality} = \text{Hazardous}) :$

$$\begin{aligned}
 &P(\text{HP} = \text{H} \mid (\text{A} = \text{Posh}), \text{TCP}, \text{D}) * P(\text{A} = \text{Posh} \mid (\text{EQ} = \text{H}), \text{L}, \text{N}) * P(\text{EQ} = \text{H}) = \\
 &(\text{E } P(\text{Housing Prices}(\text{A}=\text{Posh}) = \text{High}))/6 * \\
 &(\text{E } P(\text{Area}(\text{EQ}=\text{Hazardous}) = \text{Posh}))/4 * \\
 &(P(\text{EQ}=\text{Hazardous}))/1 = \\
 &3.12/6 * 1.1/4 * 0.26/1 = \\
 &0.52 * 0.275 * 0.26 = \\
 &\mathbf{0.03718}
 \end{aligned}$$

=> There are **3.718%** chances of housing prices to be on higher side given area to be posh and environment quality to be hazardous.