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TIME SERIES DATA ON ROAD TRANSPORT PASSENGER AND FREIGHT MOVEMENT (1951-1991)

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TIME SERIES DATA ON ROAD TRANSPORT PASSENGER AND FREIGHT MOVEMENT (1951-1991)

1. BACKGROUND

1.1. The draft on Time Series Data on Road Transport Passenger and Freight Movement (1951-1991) has been prepared by the Transport Planning Committee and approved in its meeting held on 20.11.93 (personnel given below):

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1.1.1. Subsequently, the draft document was discussed by the Highways Specifications & Standards Committee in its meeting held on 12.5.94 and opined that limitations of the time series data should also be indicated.

Accordingly, the draft was modified and again placed before the Highways Specifications & Standards Committee in its meeting held on 5.4.95. The Committee approved the draft subject to some minor corrections to be carried out and recommended its consideration by the Council. The Council in its meeting held on 1.5.95 at Ooty considered the draft and approved for printing subject to modifications to be carried out by the Convenor, Highways Specifications & Standards Committee based on comments of members.

1.2. Road transport is already the most dominant mode of transport in the country, both in passenger movement and in freight movement. It is poised for even higher positions in the years ahead as the country's economy gets liberalised and deversified. However, statistical data on various aspects of road transport are not available at one place. The information is scattered in various publications, and some of it may not be reliable. The need for a central compilation of the historical data can not be over-emphasised. It is required by planners, researchers, consultants, road transport operators, motor vehicle manufacturers and many others. Considering the importance of this data, the Transport Planning Committee of the Indian Roads Congress took up the task of compiling the time series data on passenger and freight movement by road for the period 1951-1991. The data has been collected from various sources listed at the end of the publication.

Data on certain aspects were not available for all the years. The missing values have been computed from regression equations established from available data. Notes at the end of the publication serve to explain the methodology.

At the end of the time-series data, the regression fit has been given from which the annual rate of growth can be obtained.

2. ROAD TRANSPORT PASSENGER MOVEMENT

2.1. Modes Considered

Road transport passenger movement takes place in various modes. Following modes have been considered:

(i) Bus
(ii) Car

(iii) Taxi
(iv) Two-wheeler
(v) Three-wheeler
(vi) Cycle
(vii) Cycle-Rickshaws

2.2. Passenger Movement by Buses

Table 1 gives the time-series data on kilometres (billion) accounted for by buses. The table also gives the time-series data on bus population, utilisation of buses per year and the occupancy ratio.

TABLE 1. BUS POPULATION AND PASSENGER-KM BY BUSES

Year	Population ('000)	Passenger-Km (Billion)	Utilisation per year per bus ('000 km)	Occupancy Ratio (per cent)
(1)	(2)	(3)	(4)	(5)
1951	34	35.4	37.1	54
1952	35	38.0	38.0	55
1953	39	44.2	38.9	56
1954	40	46.4	39.8	56
1955	41	49.6	40.8	57
1956	47	59.3	41.8	58
1957	38	49.9	42.8	59
1958	36	44.8	39.9	60
1959	48	69.6	46.5	60
1960	54	77.4	45.2	61
1961	57	82.4	47.1	59
1962	60	94.7	48.2	63
1963	63	103.6	49.4	64
1964	67	112.6	50.5	64
1965	70	122.6	51.8	65
1966	73	123.7	54.3	60
1967	76	143.8	54.3	67
1968	83	163.2	55.6	68
1969	87	175.0	56.9	68
1970	92	192.4	58.3	69
1971	94	209.8	58.8	73
1972	99	223.7	61.2	71
1973	95	222.7	62.6	72

(Table Contd.)

(Table Contd.)

(1)	(2)	(3)	(4)	(5)
1974	105	252.0	64.1	72
1975	114	284.3	65.7	73
1976	115	297.8	67.3	74
1977	119	318.4	73.5	70
1978	124	395.0	73.8	83
1979	133	392.6	74.7	76
1980	140	414.8	74.0	77
1981	154	544.1	79.0	86
1982	164	594.8	81.1	86
1983	178	597.9	76.9	84
1984	196	689.2	80.5	84
1985	219	738.9	80.1	81
1986	223	833.0	87.6	82
1987	241	907.0	87.2	83
1988	266	1001.6	89.4	81
1989	278	1003.4	93.8	74
1990	313	1252.3	92.7	83
1991	333	1253.3	87.2	83

The following equation is the best fit for the data on passenger-km accounted for by buses:

Bus passenger kilometres in any year n (in billion),
BPKn:

$BPKn = 33.4\ (1+0.095)^n$ ... Eqn. 1

where n = year - 1951.

The annual rate of growth is 9.5 per cent for the period 1951-91. The annual growth rates for the 10-year block periods are as under:

Block of year	Annual rate of growth of passenger - km accounted for by buses
1951 - 60	7.3
1961 - 70	9.5
1971 - 80	8.6
1981 - 91	9.2
1951 - 91	9.5

The equation for the growth of population of buses is:

Bus population in any year n, (in thousands),

$B_n = 31.5\ (1+0.053)^n$ ... Eqn. 2

where n = year - 1951

The annual rate of growth of bus population in the period 1951-91 is 5.3 per cent. The annual growth rates for the 10-year block periods are as under:

Block of years	Annual rate of growth of bus population (percentage)
1951 - 60	3.7
1961 - 70	5.4
1971 - 80	4.6
1981 - 91	8.0
1951 - 91	5.3

The utilisation of buses in terms of kilometres run per year has been showing a steady increase in the past. The following equation represents this trend:

$U_n = 37{,}086\ (1+0.024)^n$ .. Eqn. 3

where U_n = utilisation in kilometres per annum

n = year - 1951

The occupancy ratio, which is the ratio of the number of passengers travelled to the average seating capacity (taken as 52), has also been shown a steady rise. The following equation represents this trend:

$OR_n = 54+0.8n$ ... Eqn. 4

where OR_n = Occupancy ratio for the year n expressed in percentage

n = year - 1951

2.3. **Passenger Movement by Cars**

Table 2 gives the time-series data on population of cars and passenger movement by cars.

TABLE 2. CAR POPULATION AND PASSENGER-KM BY CARS

Year (1)	Population ('000) (2)	Passenger-Km (Billion) (3)
1951	105	4.2
1952	139	5.6
1953	149	6.0
1954	161	6.5
1955	174	7.0
1956	203	8.1
1957	203	8.1
1958	219	8.8
1959	236	9.5
1960	254	10.2
1961	310	12.4
1962	296	11.9
1963	320	12.8
1964	345	13.8
1965	372	14.9
1966	456	18.3
1967	433	17.3
1968	468	18.8
1969	504	20.2
1970	544	21.8
1971	683	27.4
1972	740	29.7
1973	709	28.4
1974	768	30.8
1975	766	30.7
1976	779	31.2
1977	878	35.2
1978	919	36.8
1979	996	39.9
1980	1059	42.4
1981	1160	46.5
1982	1207	48.4
1983	1385	55.5
1984	1455	58.3
1985	1607	64.4
1986	1780	71.3
1987	2007	80.4
1988	2295	92.0
1989	2486	99.6
1990	2736	109.6
1991	3013	120.7

The following equations are the best fit for the data:

(i) Car passenger-kilometres in any year n (in billion)

$CPKn = 5.2\ (1+0.079)^n$ ... Eqn. 5

where n = year - 1951

The annual rate of growth is 7.9 per cent.

(ii) Car population in thousands in any year n,

$Cn = 128.4\ (1+0.079)^n$ ... Eqn. 6

where n = year - 1951

The annual rate of growth is 7.9 per cent.

The annual growth rates for 10 year blocks are indicated below:

Blocks	Annual growth rate (per cent) of car population and passenger- km
1951 - 60	9.1
1961 - 70	7.3
1971 - 80	4.8
1981 - 91	10.5
1951 - 91	7.9

2.4. **Passenger Movement by Two Wheelers**

Table 3 gives the time-series data on population of two-wheelers and passenger movement by two-wheelers. The regression equations that have emerged are:

(i) Two-wheelers passenger kilometres in any year n, (in billion)

$TW\ PKn = 0.15\ (1+0.177)^n$ ... Eqn. 7

where n = year - 1951

The average annual rate of growth is 17.7 per cent.

(ii) Two-wheeler population in any year n, (in thousand)

$TWn = 20.4\ (1+0.177)^n$ ... Eqn. 8

where n = year-1951

The average annual rate of growth is 17.7 per cent.

The growth rates in the 10-year blocks are as below:

Blocks	Average growth rate (per cent) of two-wheeler population and passenger - km
1951 - 60	15.7
1961 - 70	18.1
1971 - 80	16.8
1981 - 91	17.7
1951 - 91	17.7

TABLE 3. TWO WHEELERS: POPULATION AND PASSENGER-KM

Year (1)	Population ('000) (2)	Passenger-Km (Billion) (3)
1951	27	0.2
1952	24	0.2
1953	28	0.2
1954	33	0.2
1955	39	0.3
1956	41	0.3
1957	54	0.4
1958	63	0.5
1959	74	0.5
1960	88	0.7
1961	88	0.7
1962	121	0.9
1963	143	1.1
1964	168	1.2
1965	198	1.5
1966	226	1.7
1967	275	2.0

(Table Contd.)

(Table Contd.)

(1)	(2)	(3)
1968	324	2.4
1969	381	2.8
1970	449	3.3
1971	576	4.3
1972	622	4.9
1973	732	5.4
1974	862	6.4
1975	1015	7.5
1976	1195	8.8
1977	1407	10.4
1978	1657	12.2
1979	1951	14.4
1980	2297	17.0
1981	2704	20.0
1982	3184	23.5
1983	3749	27.7
1984	4414	32.6
1985	5197	38.4
1986	6119	45.2
1987	7204	53.2
1988	8483	62.7
1989	9987	73.8
1990	11759	86.9
1991	13845	102.3

2.5. Passenger Movement by Three-Wheelers

Table 4 gives the time series data on population of three-wheelers passenger movement by this vehicle class. The regression equations have emerged are :

(i) Three-wheeler passenger kilometers in any year n, (in billion)

$THW\ PKn = 0.37\ (1+0.169)^n$ ... Eqn. 9

where n = year - 1961

The average annual rate of growth is 16.9 per cent.

(ii) Three-wheeler population in any year n, (in thousands)

$THWn. = 6.3\ (1+0.169)^n$ ... Eqn. 10

where n = year - 1961

The average annual rate of growth is 16.9 per cent.

The average annual growth rates for the 10-year blocks are:

Blocks	Average annual growth rate (per cent) of three-wheeler population and passenger-km
1961-70	18.6
1971-80	16.7
1981-91	16.3

2.6. **Passenger Movement by Cycles**

Table 5 gives the time series data on passenger kilometres associated with cycle. The regression equation that has emerged is:

$CPKn = 2.2\ (1+0.10)^n$ ... Eqn. 11

where CPKn = Passenger kilometres associated with cycle in any year n

n = year - 1951

The average growth rate is 10 per cent per annum. This growth rate is the same over the different 10-year blocks.

2.7. **Passenger Movement by Cycle-Rickshaws**

Table 6 gives the time series data on the passenger kilometres associated with cycle rickshaw. The regression equation for the data is:

$CRPKn = 2.6\ (1+0.033)^n$ ... Eqn. 12

Where CRPKn = Passenger kilometres associated with cycle-rickshaws in any year n

n = year - 1951

TABLE 4. THREE WHEELERS: POPULATION AND PASSENGER-KM

Year (1)	Population ('000) (2)	Passenger-Km (Billion) (3)
1961	5	0.3
1962	7	0.4
1963	9	0.5
1964	10	0.6
1965	12	0.7
1966	13	0.8
1967	16	0.9
1968	19	1.1
1969	22	1.3
1970	26	1.5
1971	30	1.8
1972	35	2.1
1973	47	2.8
1974	56	3.3
1975	62	3.7
1976	71	4.2
1977	83	4.9
1978	94	5.5
1979	110	6.5
1980	122	7.2
1981	143	8.4
1982	162	9.5
1983	182	10.7
1984	229	13.5
1985	267	15.7
1986	313	18.4
1987	386	22.8
1988	427	25.2
1989	476	28.1
1990	542	31.9
1991	610	36.0

TABLE 5. PASSENGER-KM BY CYCLES

Year (1)	Passenger-Km (Billion) (2)	Year (1)	Passenger-Km (Billion) (2)
1951	2.2	1972	16.4
1952	2.4	1973	18.0
1953	2.7	1974	19.0
1954	2.9	1975	21.8
1955	3.2	1976	24.0
1956	3.6	1977	26.4
1957	3.9	1978	29.0
1958	4.3	1979	31.5
1959	4.7	1980	35.1
1960	5.2	1981	38.7
1961	5.7	1982	42.5
1962	6.3	1983	46.8
1963	7.0	1984	51.5
1964	7.6	1985	56.6
1965	8.4	1986	62.3
1966	9.3	1987	68.5
1967	10.2	1988	75.4
1968	11.2	1989	82.9
1969	12.3	1990	91.2
1970	13.5	1991	100.4
1971	14.9		

The average growth rate is 3.3 per cent per annum.

The growth rates in the 10-year blocks are as under:

Blocks	Average Annual growth rate (per cent)
1951-60	2.3
1961-70	3.3
1971-80	4.0
1981-91	3.1
1951-91	3.3

TABLE 6. PASSENGER-KM BY CYCLE RICKSHAWS

Year (1)	Passenger-km (Billion) (2)	Year (1)	Passenger-km (Billion) (2)
1951	2.80	1972	5.09
1952	2.87	1973	5.30
1953	2.94	1974	5.52
1954	3.00	1975	5.74
1955	3.08	1976	5.98
1956	3.15	1977	6.22
1957	3.23	1978	6.48
1958	3.30	1979	6.74
1959	3.38	1980	7.02
1960	3.46	1981	7.13
1961	3.54	1982	7.39
1962	3.66	1983	7.62
1963	3.78	1984	7.86
1964	3.90	1985	8.11
1965	4.03	1986	8.36
1966	4.16	1987	8.63
1967	4.30	1988	8.90
1968	4.50	1989	9.18
1969	4.58	1990	9.47
1970	4.73	1991	9.77
1971	4.89		

2.8. **Total Passenger Kilometres by All Modes**

Table 7 gives the time series data on the passenger kilometres performed by all road transport vehicle class. The regression equation that is the best fit to the observed data is:

$$RTP\ Kn = 42.6\ (1+0.094)^n \qquad \text{... Eqn. 13}$$

where RTP Kn = Total annual road transport passenger kilometres by all vehicles classes in the year n

n = year-1951

The average growth rate is 9.4 per cent.

TABLE 7. TOTAL PASSENGER-KM BY ALL MODES

Year (1)	Passenger-km (Billion) (2)	Year (1)	Passenger-km (Billion) (2)
1951	44.80	1972	218.89
1952	49.07	1973	282.60
1953	56.04	1974	317.82
1954	59.00	1975	353.74
1955	63.18	1976	371.98
1956	74.45	1977	401.52
1957	65.53	1978	484.98
1958	61.70	1979	491.64
1959	87.68	1980	523.52
1960	96.96	1981	664.83
1961	105.04	1982	726.09
1962	117.86	1983	746.22
1963	128.78	1984	852.96
1964	139.70	1985	922.11
1965	162.13	1986	1038.56
1966	157.96	1987	1140.53
1967	178.50	1988	1265.80
1968	196.70	1989	1296.98
1969	216.18	1990	1581.37
1970	237.23	1991	1622.47
1971	263.09		

The growth rates in the 10-year blocks are as under:

Blocks	Average Annual growth rate (per cent)
1951-60	7.5
1961-70	9.1
1971-80	8.5
1981-91	9.8
1951-81	9.4

3. ROAD TRANSPORT FREIGHT MOVEMENT

3.1. Vehicle Type Considered

Road transport freight movement takes place by various vehicle types.

The following vehicle types have been considered:

(i) Heavy Commercial Vehicle (HCV)
(ii) Light Commercial Vehicle (LCV)
(iii) Three-wheelers
(iv) Agricultural tractors
(v) Animal drawn vehicles

The time series data on each of the above vehicle class is given below:

3.2. Freight Movement by HCVs

Table 8 gives the time series data on the population of HCVs and the freight moved by them. The regression equations that have emerged are given below:

(i) Freight movement by HCVs in billion tonne-kilometres for any year n,

$$HCV\ BTKn = 10.1\ (1+0.099)^n \qquad \text{... Eqn. 14}$$

where HCV BTKn = freight movement in billion tonne-km for year n
n = year-1951

The average annual rate of growth is 9.9 per cent.

The average annual growth rates for the 10 year blocks are given below:

Blocks	Average annual rate of growth of tonne-km moved by HCVs (per cent)
1951-60	11.0
1961-70	11.0
1971-80	6.3
1981-91	12.2
1951-91	9.9

(ii) The population of HCVs, in thousands, for any year, n,

$$HCVn = 82.6\ (1+0.061)^n \qquad \text{... Eqn. 15}$$

where n = year-1951

The average annual growth rate is 6.1 per cent. The average annual

growth rates for the 10-year blocks are given below:

Blocks	Average annual rate of growth of population of HCV (per cent)
1951-60	7.0
1961-70	6.9
1971-80	2.4
1981-91	9.7

TABLE 8. HCV POPULATION AND FREIGHT

Year	Population ('000)	Freight Tonne-km (Billion)
(1)	(2)	(3)
1951	82	9.77
1952	82	10.15
1953	88	11.31
1954	95	12.67
1955	102	14.12
1956	119	17.12
1957	117	17.46
1958	125	19.38
1959	135	21.73
1960	144	24.07
1961	168	29.14
1962	166	29.93
1963	178	33.28
1964	191	37.10
1965	205	41.35
1966	259	54.22
1967	236	51.36
1968	253	57.11
1969	271	63.55
1970	291	70.86
1971	301	76.21
1972	317	83.28
1973	256	69.88
1974	266	75.41
1975	272	80.06
1976	280	85.53
1977	305	96.67

(Table Contd.)

(Table Contd.)

(1)	(2)	(3)
1978	312	102.71
1979	349	119.30
1980	369	130.93
1981	440	162.22
1982	488	184.09
1983	532	205.35
1984	581	229.77
1985	640	258.96
1986	670	277.38
1987	770	326.58
1988	881	382.30
1989	926	411.10
1990	1001	455.25
1991	1101	512.28

3.3. **Freight Movement by LCVs**

Table 9 gives the time series data on the population of LCVs and the freight moved by them. The regression equations that have emerged are given below:

(i) Freight movement by LCVs in Billion Tonne-kilometres in any year n,

LCV BTKn = $0.73\ (1+0.149)^n$ ... Eqn. 16

where n = year-1961

The average annual rate of growth is 14.9 per cent. The average annual growth rates for the 10-year blocks are given below:

Blocks	Average annual rate of growth of Tonne-km moved by LCVs (per cent)
1961-70	14.8
1971-80	14.9
1981-91	14.5
1961-91	14.9

(ii) Population of LCVs in any year, n, (in thousands)

LCVs n = $15.4\ (1+0.106)^n$ ... Eqn. 17

where n = year-1961

The average annual growth rate is 10.63 per cent.

The average annual growth rates for the 10-year blocks are given below:

Blocks	Average annual rate of growth of population of LCVs (per cent)
1961-70	10.59
1971-80	10.74
1981-91	10.37
1961-91	10.63

TABLE 9. LCV POPULATION AND FREIGHT

Year	Population ('000)	Freight Tonne-km (Billion)
(1)	(2)	(3)
1961	15	0.71
1962	17	0.84
1963	19	0.97
1964	21	1.12
1965	23	1.27
1966	25	1.44
1967	28	1.67
1968	31	1.92
1969	34	2.19
1970	38	2.53
1971	42	2.93
1972	47	3.39
1973	52	3.90
1974	57	4.44
1975	64	5.17
1976	70	5.87
1977	78	6.79
1978	91	8.25

(Table Contd.)

(Table Contd.)

(1)	(2)	(3)
1979	95	8.93
1980	103	10.04
1981	114	11.56
1982	125	13.13
1983	143	15.62
1984	161	18.69
1985	182	21.47
1986	193	23.64
1987	214	27.22
1988	233	30.75
1989	253	34.65
1990	281	39.91
1991	310	45.81

3.4. Freight Movement by Three-Wheelers

Table 10 gives the time series data on the population of three-wheelers and the freight moved by them. The regressions equations that have emerged are given below:

(i) Freight movement by three-wheelers in billion-tonne-km for any year n

$$THW\ BTKn = 0.022\ (1+0.174)^n \quad \text{... Eqn. 18}$$

where n = year-1961

The average annual rate of growth is 17.4 per cent

The average annual growth rates for the 10-year blocks are given below:

Blocks	Average annual rate of growth of tonne-km moved by three wheelers (per cent)
1961-70	17.8
1971-80	19.2
1981-91	14.6
1961-91	17.4

(ii) The population of three-wheelers (freight) for any year n, (in thousands):

$THWn = 1.03\ (1+177)^n$ ... Eqn. 19
where n = year - 1961

The average annual growth rate is 17.7 per cent.

The average annual growth rates for 10-year blocks are given below:

Blocks	Average annual rate of growth of population of three-wheelers (per cent)
1961-70	19
1971-80	19.65
1981-91	14.6
1961-91	17.7

TABLE 10. THREE-WHEELERS (GOODS): POPULATION AND FREIGHT

Year (1)	Population ('000) (2)	Freight (Billion Tonne-km) (3)
1961	1.1	0.02
1962	1.5	0.03
1963	1.8	0.03
1964	2.1	0.04
1965	2.5	0.04
1966	2.8	0.05
1967	3.5	0.06
1968	4.1	0.07
1969	4.8	0.08
1970	5.7	0.10
1971	6.4	0.11
1972	7.3	0.12
1973	9.9	0.17
1974	11.6	0.19
1975	12.9	0.22
1976	14.8	0.25
1977	17.4	0.29

(Table Contd.)

(Table Contd.)

(1)	(2)	(3)
1978	24.7	0.41
1979	28.6	0.48
1980	30.7	0.51
1981	39.7	0.66
1982	44.5	0.75
1983	50.7	0.85
1984	52.6	0.88
1985	70.5	1.18
1986	77.2	1.29
1987	84.1	1.41
1988	93.3	1.56
1989	114.4	1.92
1990	135.3	2.27
1991	153.8	2.58

3.5. **Freight Movement by Agricultural Tractors**

Table 11 gives the time series data on the populations of Agricultural tractors and the freight moved by them. The regression equations that have emerged are given below:

(i) Freight movement by Agricultural tractors in billion tonne-km for any year n,

$$AGRT\ BTK_n = 34.1\ (1+0.1299)^n \quad \text{... Eqn. 20}$$

where n = year 1961

The average annual rate of growth is 13 per cent.

The average annual growth rate for the 10-year blocks are given below:

Blocks	Average annual rate of growth of tonne-km by Agricultural tractors (per cent)
1951-60	12.4
1961-70	12.6
1971-80	12.0
1981-91	11.9
1951-91	13.0

(ii) Population of Agricultural tractors for any year n, (in thousand)

$$AGRTn = 9.56\ (1+0.131)^n \quad \text{... Eqn. 21}$$

where n = year-1951

The average annual growth rate is 13.1 per cent.

The average annual growth rates for the 10-year blocks are given below:

Blocks	Average annual rate of growth of population of Agricultural tractors (per cent)
1951-60	13.9
1961-70	13.4
1971-80	12.2
1981-91	12.0
1951-91	13.1

TABLE 11. AGRICULTURAL TRACTORS: POPULATION AND FREIGHT

Year	Population ('000)	Freight Tonne-km (Billion)
(1)	(2)	(3)
1951	8.6	0.02
1952	10.8	0.02
1953	12.2	0.02
1954	13.8	0.03
1955	15.7	0.03
1956	21.0	0.04
1957	20.0	0.04
1958	22.7	0.04
1959	25.6	0.05
1960	29.0	0.05
1961	31.0	0.06
1962	37.0	0.07
1963	42.0	0.08
1964	47.4	0.09
1965	53.7	0.10
1966	54.0	0.10
1967	69.2	0.13
1968	77.6	0.14

(Table Contd.)

(Table Contd.)

(1)	(2)	(3)
1969	87.8	0.16
1970	99.3	0.18
1971	112.3	0.21
1972	148.2	0.28
1973	143.7	0.27
1974	162.5	0.30
1975	183.8	0.34
1976	207.9	0.39
1977	224.1	0.42
1978	269.7	0.50
1979	271.0	0.50
1980	359.5	0.67
1981	384.6	0.72
1982	516.4	0.96
1983	492.0	0.92
1984	556.5	1.04
1985	629.4	1.17
1986	711.8	1.32
1987	805.1	1.50
1988	910.5	1.69
1989	1024.9	1.91
1990	1145.1	2.13
1991	1232.9	2.29

3.6. **Freight Movement by Animal Drawn Vehicles**

Table 12 gives the time series data as on the freight moved by Animal drawn vehicles. The regression equation that has emerged is given below:

Freight movement by Animal drawn vehicle in billion tonne-km for any year n,

$$\text{ADV BTKn} = 2.28\ (1+0.012)^{n} \qquad \text{... Eqn. 22}$$

where n = year-1951

The average annual rate of growth is 1.2 per cent.

The average annual growth rate for the 10-year blocks are given below:

Blocks	Average annual rate of growth of tonne-km moved by ADVs (per cent)
1951-60	1.0
1961-70	1.2
1971-80	1.0
1981-91	1.4
1951-91	1.2

TABLE 12. ANIMAL DRAWN VEHICLES: FREIGHT

Year	Freight (Billion T-km)	Year	Freight (Billion T-km)
(1)	(2)	(1)	(2)
1951	2.3	1972	2.9
1952	2.3	1973	3.0
1953	2.4	1974	3.0
1954	2.4	1975	3.0
1955	2.4	1976	3.1
1956	2.4	1977	3.1
1957	2.5	1978	3.1
1958	2.5	1979	3.1
1959	2.5	1980	3.2
1960	2.5	1981	3.2
1961	2.6	1982	3.2
1962	2.6	1983	3.3
1963	2.6	1984	3.3
1964	2.7	1985	3.4
1965	2.7	1986	3.4
1966	2.7	1987	3.5
1967	2.8	1988	3.5
1968	2.8	1989	3.6
1969	2.8	1990	3.6
1970	2.9	1991	3.7
1971	2.9		

3.7. **Total Freight Movement by All Modes**

Table 13 gives the time series data on total freight movement by all modes. The following regression equation represents the best fit to the data:

$$RTF\ Kn = 11.68\ (1+0.973)^n \quad \text{... Eqn. 23}$$

where RTFKn = Road transport freight movement in Billion Tonne/km by all modes for any year n

n = year-1951

The average annual rate of growth is seen to be 9.73 per cent.

The annual growth rates for the 10-year block periods are given below:

Blocks	Annual rate of growth (per cent)
1951-60	9.6
1961-70	10.5
1971-80	6.6
1981-91	12.3
1951-91	9.7

TABLE 13. TOTAL FREIGHT MOVEMENT

Year (1)	Freight (Billion T-km) (2)	Year (1)	Freight (Billion T-km) (2)
1951	12.09	1972	89.97
1952	12.47	1973	77.22
1953	13.73	1974	83.34
1954	15.10	1975	88.79
1955	16.55	1976	95.14
1956	19.56	1977	107.27
1957	20.00	1978	114.97
1958	21.92	1979	132.31
1959	24.28	1980	145.35
1960	26.62	1981	178.36
1961	32.53	1982	202.13
1962	33.47	1983	226.04
1963	36.96	1984	253.68
1964	41.05	1985	286.18
1965	45.46	1986	307.03
1966	58.51	1987	360.21
1967	56.02	1988	419.80
1968	62.04	1989	453.18
1969	68.78	1990	503.16
1970	76.57	1991	566.66
1971	82.36		

4. USE OF DATA

The time-series data at the National Level has been assembled from various secondary sources, and after making certain assumptions to fill in the gaps in the information. In using the data, these limitations should be kept in view. The time-series data establishes the past trend, and any projections to the future must be done with caution. For short-term future demand projections, the immediate past trend may be a good indicator, but for long-term future projections the past trends can only be a guide. Future projections can be done only after relating the transport demand to important economic indicators, and after considering different scenario of economic growth.

NOTES

1. The data on the population of various types of vehicles has been assembled from various sources listed in the Bibliography. Where data for a particular year is not available, the regression analysis has been carried out without that data and the value predicted from the regression equation has been inserted.

2. The passenger-km accounted for by buses has been calculated from:

$$BPKn = \frac{Bn \times Un \times ORn \times 52}{10^8}$$

where BPKn = Bus passenger km in billion in year n
Bn = Bus population in thousands in year n
Un = Utilisation of buses in km per annum in year n
ORn = Occupancy ratio in year n in percentage

The multiplying factor 52 is on account of the assumed seating capacity of buses.

3. The passenger km accounted for by passenger cars has been calculated from:

$$CPKn = \frac{Cn \times 12{,}600 \times 3.18}{10^6}$$

where CPKn = Passenger km by cars in billion in the year n
Cn = Population of cars in thousands in the year n

The multiplying factor of 12,600 is on account of the annual utilisation of cars in km.

The multiplying factor of 3.18 is on account of average occupancy of a car.

4. The passenger km by two-wheelers has been calculated from:

$$TWPKn = \frac{TWn \times 6{,}300 \times 1.5}{10^6}$$

where TWPKn = Passenger km by two-wheelers in billion in the year n

TWn = Population of two-wheelers in thousands in the year n

The multiplying factor of 6,300 is on account of the annual utilisation in km.

The multiplying factor of 1.5 is on account of the average occupancy of two wheelers.

5. The passenger km accounted for by three-wheelers has been calculated from:

$$\text{THW PKn} = \frac{\text{THWn} \times 91.75 \times 365 \times 1.76}{10^6}$$

where THW PKn = Passenger km by three-wheelers in billion in the year n

THWn = Three-wheeler population in the year n in thousands

The multiplying factor 91.75 x 365 takes into account a daily utilisation of 91.75 km.

The multiplying factor of 1.76 is on account of the average occupancy of a three-wheeler.

6. The passenger km accounted for by cycles has been calculated from:

$$\text{CPKn} = \frac{\text{Cn} \times 5 \times 365}{10^6}$$

where CPKn = Passenger km by cycles in billion in the year n

Cn = Cycle population in thousands in the year n

The multiplying factor of 5 x 365 takes into account the daily utilisation of cycles upto 5 km.

7. The passenger km by cycle rickshaws has been calculated from:

$$CRPKn = \frac{CRn \times 20.3 \times 365 \times 1.73}{10^6}$$

where CRPKn = Cycle rickshaw passenger km in the year n in billion
CRn = Population of cycle rickshaws in thousands in the year n

The multiplying factor of 20.3 x 365 takes into account the daily utilisation of 20.3 km by a cycle rickshaw.

The multiplying factor of 1.73 takes into account the average occupancy of cycle rickshaws.

8. The freight movement by heavy commercial vehicles has been calculated from:

$$HCVBTKn = \frac{HCVn \times Un \times Wn}{10^6}$$

where HCVn = Population of heavy commercial vehicles in thousands in the year n
Un = Average annual utilisation of trucks in the year n given by:
$Un = 28{,}910\ (1.019)^n$
where n = year-1951
Wn = Average load carried by a truck in the year n given by:
$Wn = 4.12\ (1.019)^n$
for the period 1951-81
and $Wn' = 7.25\ (1.0045)^{n'}$
for the period 1981-91
n' = year-1981

9. The freight movement accounted for by Light Commercial Vehicles is given by:

$$LCVBTKn = \frac{LCVn \times Un \times Wn}{10^6}$$

where LCVBTKn = Annual tonne-km by LCVs in billion in the year n

LCVn = Population of LCVs in thousands in the year n

n = year-1961

Un' = Utilisation in the year n' in km per annum given by:

$$Un' = \frac{134 \times 365}{(1+0.019)^{n'}}$$

where 134 x 365 is the annual utilisation in km in the year 1990 and n' = 1990-year

Wn' = Average load carried in the year n' in tonnes given by:

$$Wn' = \frac{2.80}{(1+0.019)n'}$$

where 2.80 tonne is the average load carried in the year 1990 and n' = 1990-year

10. The freight movement accounted for by three-wheelers is given by:

$$THW\ BTKn = \frac{THWn \times 91.75 \times 365 \times 0.5}{10^6}$$

The multiplying factor of 91.75 x 365 is on account of a daily utilisation of 91.75 km.

The multiplying factor of 0.5 is on account of average load of 0.5 tonne.

11. The freight movement by three-wheelers is calculated as below:

$$AGRT\ BTKn = \frac{AGRTn \times 1860}{10^6}$$

where AGRT BTKn = Annual freight in billion tonne km in the year n

AGRTn = Population of agricultural tractors in thousands in the year n

n = year-1951

The multiplying factor of 1860 is on account of the average 1860 tonne-km by an agricultural tractors.

12. The annual tonne-km accounted for by animal drawn vehicles is given by:

$$\text{ADV BTKn} = \frac{\text{ADVn} \times 265 \times 3 \times 0.285}{10^6}$$

where ADV BTKn = Annual freight movement by animal drawn vehicles in billion in the year n

ADVn = Population of animal drawn in thousands in the year n

The multiplying factor of 265 is for accountancy for 265 trips in a year.

The multiplying factor of 3 is for accounting for an average lead of 3 km.

The multiplying factor of 0.285 is for accounting for an average load of 0.285 tonnes.

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