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## Forecast based on different data types: A before and after study (Revealed Preference)

M Vrtic

Travel Survey Metadata Series

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### Abstract

In addition to adequate data, the formulation of transport forecasts relies upon a knowledge of the relationships between the demand for transport and those factors which influence it. These relationships are described with mathematical functions and their model parameters. The parameters derived from revealed preference (RP) data are often subject to too many imperfections and are thus of only limited value in many cases. The main cause of this uncertainty is data which is either insufficiently detailed or unsuitable for estimating transport demand functions. For this reason, an earlier SVI study concerning the sensitivity of passenger transport to supply-side and price changes recommended that research should be conducted in parallel with major transport infrastructure investments. In this way this recommended project would be able to check and validate the quality of the findings from alternative or supplementary stated preference (SP) (Vrtic et al., 2000), as both forecast and actual changes in demand would be known to it. The launch of intercity tilting-trains (known as ICNs) in 2001 and further supply-side improvements to road and rail transport supply offered an opportunity to conduct ex ante/ex post surveys in order to verify the forecasting approaches in a defined period. This mix of qualitative and quantitative changes is a particular challenge for forecasting and the attendant data collection process. Nonetheless, it is a challenge that must be overcome again and again in day-to-day practice. As the supply-side changes are generally small, it was expected that changes on the demand side will be concentrated at the level of mode and route choice. The principal aim of this research remit was to verify and identify the limits and possibilities of the three data sources for forecasting by means of an ex ante/ex post analysis. However, this study also offered an opportunity to analyse other aspects of importance to transport forecasting. Here, in addition to the study methodology, the quality and accessibility of the available bodies of data proved to be crucial factors in modelling transport movements and events. In a first stage the study estimated a detailed public transport route choice model and calibrated national network models for both road and rail demand. This is an essential preliminary stage to the calculation of modal shifts in demand for transport and the subsequent review of the different forecasts. In the case of mode choice changes, the three most common approaches to forecasting were to be tested: • Direct elasticity, known from previous studies • RP models, i.e. model parameters based on RP data • SP models, i.e. model parameters based on SP data The primary benefits of this study can be summarized as follows: - It sets out the opportunities and limits, as well as the advantages and disadvantages, of the three data sources for forecasting under review. - This is the first study to provide models of route and mode choice which have been estimated from SP data. The model parameters estimated using this data provide the basis for the practical application of

mode and route choice models following supply-side transport changes. - The estimated model parameters, current figures and the relative valuations demonstrate the importance of individual variables to mode and route choice. They were estimated for each trip purpose. - The study showed that in this case the forecasts derived from the SP-data were more consistent and more precise than either the estimates from the direct elasticities or the RP data. - Verifying transport forecasts shows how and where further improvements can or must still be made with regard to both data bases and methodology. - The study describes the possibilities and methodical foundation for common SP/RP estimates of model parameters.

## **Keywords**

Route and mode choice

## **Preferred citation style**

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# 1.0 Document Description

## Citation

Title: Forecast based on different data types: A before and after study (Revealed Preference )

Identification Number: KEP RP

Authoring Entity: Institute for Transport Plannig and Systems (IVT) (ETH Zurich)

Other identifications and acknowledgements: Vtric M.

Producer: Vtric M.

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## 2.0 Study Description

### Citation

Title:	Forecast based on different data types: A before and after study (Revealed Preference)
Identification Number:	KEP RP
Authoring Entity:	Mr. M. Vrtic (Institute for Transport Planning and Systems, ETH Zurich) Prof. KW Axhausen (Institute for Transport Planning and Systems, ETH Zurich)
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## Study Scope

**Keywords:** Route and mode choice , Stated preference , Revealed preference , Public transport , Tilting trains , Institute for Transport Planning and Systems

**Topic Classification:** Revealed preference , Stated preference

**Abstract:** In addition to adequate data, the formulation of transport forecasts relies upon a knowledge of the relationships between the demand for transport and those factors which influence it. These relationships are described with mathematical functions and their model parameters. The parameters derived from revealed preference (RP) data are often subject to too many imponderables and are thus of only limited value in many cases. The main cause of this uncertainty is data which is either insufficiently detailed or unsuitable for estimating transport demand functions. For this reason, an earlier SVI study concerning the sensitivity of passenger transport to supply-side and price changes recommended that research should be conducted in parallel with major transport infrastructure investments. In this way this recommended project would be able to check and validate the quality of the findings from alternative or supplementary stated preference (SP) (Vrtic et al., 2000), as both forecast and actual changes in demand would be known to it. The launch of intercity tilting-trains (known as ICNs) in 2001 and further supply-side improvements to road and rail transport supply offered an opportunity to conduct ex ante/ex post surveys in order to verify the forecasting approaches in a defined period. This mix of qualitative and quantitative changes is a particular challenge for forecasting and the attendant data collection process. Nonetheless, it is a challenge that must be overcome again and again in day-to-day practice. As the supply-side changes are generally small, it was expected that changes on the demand side will be concentrated at the level of mode and route choice. The principal aim of this research remit was to verify and identify the limits and possibilities of the three data sources for forecasting by means of an ex ante/ex post analysis. However, this study also offered an opportunity to analyse other aspects of importance to transport forecasting. Here, in addition to the study methodology, the quality and accessibility of the available bodies of data proved to be crucial factors in modelling transport movements and events. In a first stage the study estimated a detailed public transport route choice model and calibrated national network models for both road and rail demand. This is an essential preliminary stage to the calculation of modal shifts in demand for transport and the subsequent review of the different forecasts. In the case of mode choice changes, the three most common approaches to forecasting were to be tested: • Direct elasticity, known from previous studies •

RP models, i.e. model parameters based on RP data • SP models, i.e. model parameters based on SP data The primary benefits of this study can be summarized as follows: - It sets out the opportunities and limits, as well as the advantages and disadvantages, of the three data sources for forecasting under review. - This the first study to provide models of route and mode choice which have been estimated from SP data. The model parameters estimated using this data provide the basis for the practical application of mode and route choice models following supply-side transport changes. - The estimated model parameters, current figures and the relative valuations demonstrate the importance of individual variables to mode and route choice. They were estimated for each trip purpose. - The study showed that in this case the forecasts derived from the SP-data were more consistent and more precise than either the estimates from the direct elasticities or the RP data. - Verifying transport forecasts shows how and where further improvements can or must still be made with regard to both data bases and methodology. - The study describes the possibilities and methodical foundation for common SP/RP estimates of model parameters.

Country: Switzerland

Geographic Coverage: Switzerland

Unit of Analysis: Person

Universe: All the individuals permanently residing in Switzerland.

## **Methodology and Processing**

Time Method: 9 months (January 2001 to September 2001)

Sampling Procedure: Sample frame: All the individuals of age 15-84, residing permanently in Switzerland  
Sample unit: Person or Individual  
Sampling technique: Random sampling

Mode of Data Collection: Self-Administrative and structured written interview technique was implemented.

## **Sources Statement**

Weighting:           No weighting was done.

## **Other Study Description Materials**

### **Related Materials**

#### **Citation**

Title: Revealed preference questioannaire

Holdings  
Information: [www.ivt.baug.ethz.ch/ethda/kep/rp/questioannaire.pdf](http://www.ivt.baug.ethz.ch/ethda/kep/rp/questioannaire.pdf)

## **3.0 File Description**

### **File: Revealed Preference.NSDstat**

- Number of cases: 46051
- No. of variables per record: 24
- Type of File: NSDstat 200203

## 4.0 Variable Description

List of Variables:

- [Interview Number](#)
- [Mode choice](#)
- [Travel time with car \(in hours\)](#)
- [Travel time with train \(in hours\)](#)
- [Travel cost with car \( in CHF\)](#)
- [Travel cost with train \(in CHF\)](#)
- [Number of transfers](#)
- [Transfer time \(in hours\)](#)
- [Headway \(in hours\)](#)
- [Train station access time \(in hours\)](#)
- [Rural highway access time \(in hours\)](#)
- [Train station egress time \(in hours\)](#)
- [Rural highway egress time \(in hours\)](#)
- [Employed](#)
- [Occupation](#)
- [Cars ownership](#)
- [Car availability](#)
- [Age \( in years\)](#)
- [Gender](#)
- [Number of km travelled by car in the last year](#)
- [Season ticket availability](#)
- [Trip purpose](#)
- [Mode choice to train station](#)
- [Person in household](#)

# Variables

***Variable: Interview Number***

Location: *Range of Valid Data Values: 3 to 71569*

Width: 11 **Summary Statistics:**

*Variable Format: numeric*

**Variable: Mode choice**

Location:	Value	Label	Frequency
Width: 11	1 .	Car	35748
	2 .	Train	10303

*Range of Valid Data Values: 1 to 2*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 1*

*Maximum : 2*

*Mean : 1.224*

*Standard deviation : 0.417*

*Variable Format: numeric*

***Variable: Travel time with car (in hours)***

Location:                   **Summary Statistics:**

Width: 13                   *Minimum* : 0.00558

*Maximum* : 6.343

*Mean* : 0.626

*Standard deviation* : 0.719

*Variable Format*: numeric

***Variable: Travel time with train (in hours)***

Location:                   **Summary Statistics:**

Width: 13                    *Minimum : 0*

*Maximum : 10.45*

*Mean : 0.804*

*Standard deviation : 0.972*

*Variable Format: numeric*

***Variable: Travel cost with car ( in CHF)***

Location:                   **Summary Statistics:**

Width: 13                    *Minimum : 0.0287*

*Maximum : 57.966*

*Mean : 4.86*

*Standard deviation : 6.556*

*Variable Format: numeric*

***Variable: Travel cost with train (in CHF)***

Location:                   **Summary Statistics:**

Width: 11                    *Minimum : 0.0897*

*Maximum : 92.807*

*Mean : 6.377*

*Standard deviation : 8.716*

*Variable Format: numeric*

***Variable: Number of transfers***

Location:                   **Summary Statistics:**

Width: 11                    *Minimum : 0*

*Maximum : 4.2*

*Mean : 0.626*

*Standard deviation : 0.792*

*Variable Format: numeric*

***Variable: Transfer time (in hours)***

Location:                   **Summary Statistics:**

Width: 11                    *Minimum : 0*

*Maximum : 2.017*

*Mean : 0.108*

*Standard deviation : 0.18*

*Variable Format: numeric*

***Variable: Headway (in hours)***

Location:                   **Summary Statistics:**

Width: 13                    *Minimum : 0.15*

*Maximum : 12*

*Mean : 0.863*

*Standard deviation : 0.583*

*Variable Format: numeric*

**Variable: Train station access time (in hours)**

Location:	Value	Label	Frequency
Width: 13	0.0166666666666667 .		454
	0.0333333333333333 .		1823
	0.05 .		2820
	0.0666666666666667 .		1627
	0.0833333333333333 .		8571
	0.1 .		918
	0.1166666666666667 .		2500
	0.1333333333333333 .		1403
	0.15 .		116
	0.1666666666666667 .		8362
	0.1833333333333333 .		85
	0.2 .		1003
	0.2166666666666667 .		103
	0.2333333333333333 .		60
	0.25 .		4306
	0.26575130503214 .		3097
	0.26575130503214 .		80
	0.2666666666666667 .		23
	0.2833333333333333 .		48
	0.29850225993438 .		1615
	0.29850225993438 .		19
	0.3 .		35
	0.31235233459435 .		10
	0.3166666666666667 .		4
	0.3249146815004 .		36
	0.3296290224825 .		6
	0.33268257600103 .		15
	0.3333333333333333 .		2374
	0.33640452171088 .		13

0.34698925610849 .	946
0.35991835268375 .	1
0.3659446135212 .	24
0.366666666666667 .	7
0.36943487044126 .	1
0.37171239644573 .	6
0.37331591883654 .	15
0.38255554326822 .	14
0.38255554326822 .	812
0.38766645679422 .	1
0.39259068656607 .	6
0.39451112867323 .	1
0.39734150785915 .	8
0.40011376999286 .	3
0.4019308298395 .	22
0.40416832165136 .	19
0.41066683551072 .	446
0.41066683551072 .	19
0.416666666666667 .	478
0.41934039884292 .	2
0.42279664440471 .	1
0.42444412259061 .	6
0.43392978835802 .	19
0.43392978835802 .	266
0.43963848224579 .	9
0.44618690298971 .	9
0.44748306768741 .	6
0.45048507064974 .	16
0.4537851051296 .	1
0.4537851051296 .	225
0.47111272696986 .	3

0.47111272696987 .	76
0.47708322990119 .	1
0.47952796302322 .	3
0.48527217673457 .	2
0.48648969482324 .	98
0.49203279960707 .	1
0.4993723580422 .	2
0.5 .	626
0.50031504374361 .	65
0.51287630375072 .	11
0.52438757411258 .	2
0.52438757411258 .	19
0.53501260998267 .	2
0.54487948810727 .	4
0.55409028908998 .	5
0.56272770030073 .	7
0.57085964519863 .	1
0.57602841299936 .	1
0.58333333333333 .	39
0.5858240687166 .	1
0.59274432812969 .	1
0.59717440822098 .	1
0.59933788490923 .	1
0.60563450228706 .	2
0.62298557434697 .	2
0.63842572609206 .	1
0.66499938300263 .	1
0.66666666666667 .	70
0.67661885194624 .	3
0.69733678589877 .	1
0.75 .	60

1 .	13
1.25 .	2
2 .	9

*Total Responses:* Summation of listed categories: 46051

**Summary Statistics:**

*Minimum :* 0.0167

*Maximum :* 2

*Mean :* 0.184

*Standard deviation :* 0.122

*Variable Format:* numeric

***Variable: Rural highway access time (in hours)***

Location:                   **Summary Statistics:**

Width: 13                   *Minimum* : 0.142

*Maximum* : 0.385

*Mean* : 0.159

*Standard deviation* : 0.0188

*Variable Format*: numeric

**Variable: Train station egress time (in hours)**

Location:	Value	Label	Frequency
Width: 13	0.26575130503214 .		16236
	0.26575130503214 .		1464
	0.29850225993438 .		7537
	0.29850225993438 .		931
	0.31235233459435 .		151
	0.31667109222941 .		52
	0.3249146815004 .		798
	0.3296290224825 .		39
	0.33268257600103 .		487
	0.33640452171088 .		171
	0.34698925610849 .		5484
	0.35268324694693 .		1
	0.35489496441492 .		12
	0.35680080318702 .		9
	0.35991835268375 .		30
	0.36236136195856 .		12
	0.3659446135212 .		323
	0.36943487044126 .		48
	0.37171239644573 .		75
	0.37331591883654 .		81
	0.37450614620681 .		60
	0.3761549796522 .		3
	0.37724308905637 .		18
	0.38255554326822 .		465
	0.38255554326822 .		2708
	0.38513522418815 .		31
	0.38766645679422 .		14
	0.38866579134617 .		1
	0.39015104309072 .		25

0.39259068656607 .	163
0.39451112867323 .	41
0.39734150785915 .	129
0.40011376999286 .	63
0.4019308298395 .	400
0.40416832165136 .	278
0.40549324989035 .	10
0.41066683551072 .	2553
0.41066683551072 .	195
0.41380265707602 .	15
0.41424475942405 .	6
0.41483199241859 .	5
0.41564986328399 .	7
0.41686748187798 .	29
0.41773055601585 .	14
0.41887283399313 .	21
0.41934039884292 .	29
0.42045601570985 .	2
0.42067047817729 .	1
0.42173772974405 .	1
0.42279664440471 .	48
0.42444412259061 .	97
0.42566672897345 .	4
0.42661008470083 .	33
0.42847734442949 .	2
0.43392978835802 .	190
0.43392978835802 .	962
0.43813945257221 .	24
0.43917180829978 .	35
0.43963848224579 .	34
0.44087517312796 .	26

0.44222267078712 .	8
0.44279610893152 .	1
0.444219219911 .	11
0.44618690298971 .	137
0.44748306768741 .	70
0.44908611537958 .	6
0.45048507064974 .	223
0.4537851051296 .	26
0.4537851051296 .	839
0.45545444841143 .	1
0.45639926358893 .	4
0.46078722703962 .	41
0.46148193568433 .	12
0.4627235723211 .	53
0.47111272696986 .	51
0.47111272696987 .	427
0.47708322990119 .	10
0.47791528977508 .	12
0.47952796302322 .	67
0.48054441118591 .	20
0.48071308841702 .	43
0.4815533736844 .	8
0.48354928242951 .	3
0.48527217673457 .	100
0.48648969482324 .	339
0.48648969482324 .	11
0.49125450364779 .	18
0.49158859950697 .	5
0.49203279960707 .	3
0.4993723580422 .	7
0.50031504374361 .	237

0.50881524317 .	2
0.51287630375072 .	78
0.52438757411258 .	19
0.52438757411258 .	100
0.53501260998267 .	40
0.53501260998267 .	49
0.54487948810727 .	37
0.55081124046216 .	2
0.55409028908998 .	78
0.56132491114181 .	7
0.56272770030073 .	45
0.57085964519863 .	7
0.57602841299936 .	4
0.57854260753205 .	13
0.5858240687166 .	15
0.59274432812969 .	6
0.59717440822098 .	12
0.59933788490923 .	8
0.60563450228706 .	12
0.61166003820677 .	7
0.62298557434697 .	3
0.63346510717751 .	2
0.63842572609206 .	1
0.63981149919799 .	4
0.65233771649547 .	1
0.65668573439349 .	3
0.66499938300263 .	6
0.67661885194624 .	7
0.69733678589877 .	6
0.70666140148178 .	1

*Total Responses:* Summation of listed categories: 46051

**Summary Statistics:**

*Minimum* : 0.266

*Maximum* : 0.707

*Mean* : 0.327

*Standard deviation* : 0.0683

*Variable Format*: numeric

***Variable: Rural highway egress time (in hours)***

Location:                    **Summary Statistics:**

Width: 13                    *Minimum* : 0.142

*Maximum* : 0.385

*Mean* : 0.159

*Standard deviation* : 0.0188

*Variable Format*: numeric

***Variable: Employed***

Location:	<b>Value</b>	<b>Label</b>	<b>Frequency</b>
Width: 11	1 .	Fultime	36666
	2 .	Parttime	0
	3 .	Unemployed	0

*Range of Valid Data Values: 0 to 1*

*Total Responses: Summation of listed categories: 36666*

**Summary Statistics:**

*Minimum : 0*

*Maximum : 1*

*Variable Format: numeric*

***Variable: Occupation***

Location:	<b>Value</b>	<b>Label</b>	<b>Frequency</b>
Width: 11	1 .	Selfemployed	3764
	2 .	Employee	32902
	3 .	No occupation	9385

*Range of Valid Data Values: 1 to 3*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 1*

*Maximum : 3*

*Variable Format: numeric*

***Variable: Cars ownership***

Location:	Value	Label	Frequency
Width: 11	0 .		3350
	1 .		42701

*Range of Valid Data Values: 0 to 1*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 0*

*Maximum : 1*

*Mean : 0.927*

*Standard deviation : 0.26*

*Variable Format: numeric*

***Variable: Car availability***

Location:	<b>Value</b>	<b>Label</b>	<b>Frequency</b>
Width: 11	1 .	Always	39295
	2 .	After arrangement	0
	3 .	No	0

*Range of Valid Data Values: 0 to 1*

*Total Responses: Summation of listed categories: 39295*

**Summary Statistics:**

*Minimum : 0*

*Maximum : 1*

*Variable Format: numeric*

***Variable: Age ( in years)***

Location:	Value	Label	Frequency
Width: 11	15 .		193
	16 .		466
	17 .		520
	18 .		733
	19 .		800
	20 .		894
	21 .		711
	22 .		751
	23 .		714
	24 .		672
	25 .		634
	26 .		701
	27 .		747
	28 .		924
	29 .		513
	30 .		1626
	31 .		775
	32 .		1093
	33 .		1189
	34 .		1040
	35 .		1430
	36 .		1166
	37 .		1243
	38 .		1340
	39 .		997
	40 .		1635
	41 .		896
	42 .		1364
	43 .		1143

44 .	913
45 .	1230
46 .	826
47 .	924
48 .	833
49 .	784
50 .	1204
51 .	423
52 .	677
53 .	916
54 .	932
55 .	858
56 .	748
57 .	648
58 .	786
59 .	572
60 .	791
61 .	496
62 .	384
63 .	298
64 .	334
65 .	512
66 .	284
67 .	288
68 .	279
69 .	248
70 .	345
71 .	161
72 .	232
73 .	192
74 .	121

75 .	215
76 .	96
77 .	114
78 .	92
79 .	79
80 .	149
81 .	33
82 .	41
83 .	28
84 .	55

*Range of Valid Data Values:* 15 to 84

*Total Responses:* Summation of listed categories: 46051

**Summary Statistics:**

*Minimum :* 15

*Maximum :* 84

*Mean :* 41.576

*Standard deviation :* 14.769

*Variable Format:* numeric

***Variable: Gender***

Location:	<b>Value</b>	<b>Label</b>	<b>Frequency</b>
Width: 11	0 .	Female	19290
	1 .	Male	26761

*Range of Valid Data Values: 0 to 1*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 0*

*Maximum : 1*

*Variable Format: numeric*

**Variable: Number of km travelled by car in the last year**

Location:	Value	Label	Frequency
Width: 11	0 .		12620
	1000 .		246
	2000 .		323
	3000 .		349
	4000 .		254
	5000 .		1059
	6000 .		559
	7000 .		682
	8000 .		1448
	9000 .		478
	10000 .		5674
	11000 .		291
	12000 .		2197
	13000 .		328
	14000 .		237
	15000 .		5584
	16000 .		115
	17000 .		359
	18000 .		703
	19000 .		6
	20000 .		4281
	21000 .		23
	22000 .		204
	23000 .		103
	24000 .		134
	25000 .		2488
	26000 .		62
	27000 .		132
	28000 .		141

30000 .	2153
32000 .	8
33000 .	12
35000 .	476
38000 .	39
40000 .	754
42000 .	10
45000 .	137
46000 .	14
48000 .	26
50000 .	498
55000 .	14
60000 .	160
65000 .	13
70000 .	56
74000 .	2
75000 .	6
80000 .	80
90000 .	30
99000 .	483

*Range of Valid Data Values: 0 to 99000*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 0*

*Maximum : 99000*

*Mean : 13413.237*

*Standard deviation : 14917.465*

*Variable Format: numeric*

***Variable: Season ticket availability***

Location:	<b>Value</b>	<b>Label</b>	<b>Frequency</b>
Width: 11	0 .	Without PT-cars	23407
	1 .	Annual season tickets	3453
	2 .	Half-Price-Discoun	15941
	3 .	Other PT-card	3250

*Range of Valid Data Values: 0 to 3*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 0*

*Maximum : 3*

*Variable Format: numeric*

***Variable: Trip purpose***

Location:	<b>Value</b>	<b>Label</b>	<b>Frequency</b>
Width: 11	1 .	Commuters	22012
	2 .	Business	1363
	3 .	Shopping	6854
	4 .	Leisure/vacation	15822

*Range of Valid Data Values: 1 to 4*

*Total Responses: Summation of listed categories: 46051*

**Summary Statistics:**

*Minimum : 1*

*Maximum : 4*

*Variable Format: numeric*

***Variable: Mode choice to train station***

Location:	Value	Label	Frequency
Width: 4	0 .	No	8023
	1 .	Walk	17314
	2 .	Urban train/bus	8948
	3 .	Cars as driver	6754
	4 .	Cars as passenger	1131
	5 .	Bicycle	3172
	6 .	Motorbike, bike	286
	7 .	Taxi	297
	8 .	Others	57
	9 .	Unknown	69

*Total Responses:* Summation of listed categories: 46051

**Summary Statistics:**

*Variable Format:* character

***Variable: Person in household***

Location:                    *Range of Valid Data Values: 1 to 13*

Width: 11                    **Summary Statistics:**

*Minimum : 1*

*Maximum : 13*

*Mean : 2.874*

*Standard deviation : 1.379*

*Variable Format: numeric*