

7/22/2023

# **Biostatistics**

**L VIII** 

PROF. DR. WAQAR AL-KUBAISY

23 -7-2023

# The marks of 12 students

80 80 80 80 80 80 80 80 80 80 80

what is the mean

what is the SD

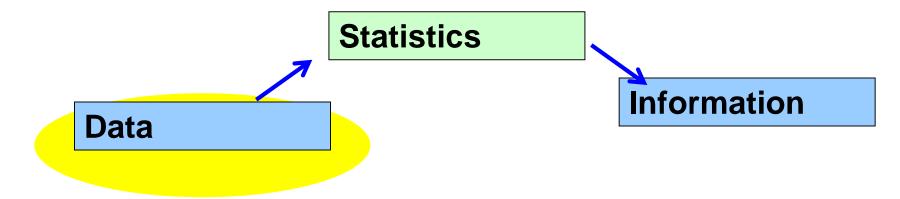
80 80 80 80 80 82 85 85 88 88 89

# SAMPLING METHODS Part 1

#### **LEARNING OBJECTIVES**

- Learn the reasons for sampling
- Distinguish between probability & non probability sampling
- Develop an understanding about different sampling methods

# Statistics is a tool for converting *data* into *information*:



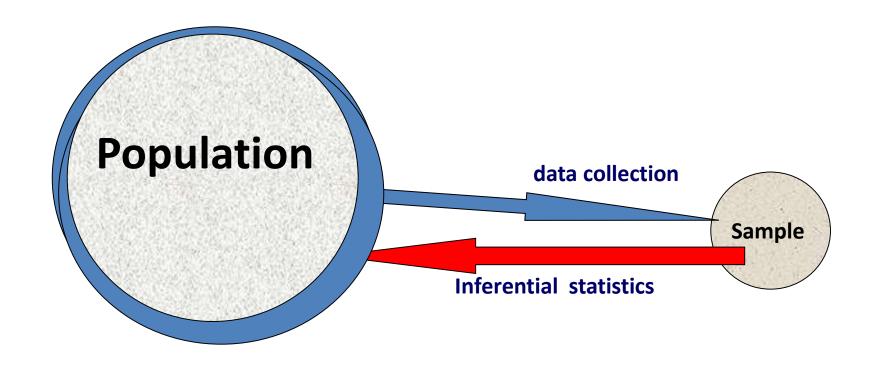
where does *data* come from?

How is it gathered?

How do we ensure its accurate?

Is the data reliable?

Is it **Representative** of the population from which it was drawn?



a sound generalized information about the population from which the sample has been drown, depending on evidence of this sample

# Population & Sampling Unobserved & Observed

Generally any set of observed data is a part of a large aggregate of potential, but unobserved data,

the observed data called sample whereas

the unobserved large group is called a population.

# Population or " universe "

- ☐ A population can be defined as all people or items with the characteristic, one wishes to understand/study .
- ☐ Is a group of entities, having some quantifiable characteristic in common, for which we have an interest at a particular time..
- The group (unit) may be people, machines, animal, bacteria ....Or it is not limited to population
- They may be **finite or infinite** in No.
- ❖ The quantifiable variable or characteristic may be 22/7/2023 continuous or a discrete variable ..

- Population also described as a <u>set of data</u> consist of all hypothetically possible observation of a given phenomenon.
- ☐ Therefore population is; a full set of individuals to whom we limit any discussion or inference .

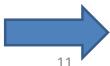
- **☐** When might you sample the entire population?
  - •When your population is very small
  - •When you have extensive( large) resources
  - •When you don't expect a very high response
  - Data gathered from entire population : Census

#### Cont. ...SAMPLES

# The first questions that the worker must ask himself are:

- What data do I need ??
- Can I investigate the problem by mean of sample ?
- If so what is the sample size should be representative
- How could we chose the sample ?

Data gathered in experiments and observational studies come from samples.



#### **SAMPLES**

- •A sample is a subset of population
- It is a subset of population, that had been chosen from population under study, in a way that it should be
- representative to whole population.
- •A sample is "a smaller (but hopefully representative) collection of units from a population, used to determine
- truths about that population"
- ❖ Sample is of interest not in its own right, but for what it tells the investigator about the population .
- Therefore care must be taken to ensure that the sample is truly represents the population about which information is required

#### CONT. ...SAMPLES

- Its some finite No. of the unit from population of individual.
- It is part of population .
  - The main objective of most statistical or studies
  - is to make sound generalization of information on the basis of sample about the population from which the sample comes.
  - ☐ This one is achieved through.
  - choosing the sample from the population under study in a way that it should be representative to whole population
  - Making inference from a sample to a population is called as statistical inference.

#### Cont. ...SAMPLES

**❖** Sample is a set of data that consist of only a part of these observation (population).

# •Why sample?

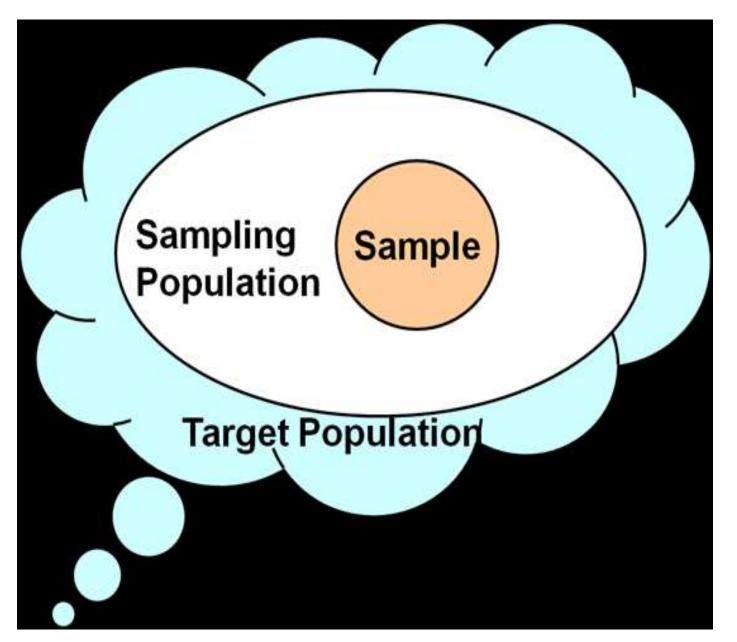
Resources (time, money) and workload

Gives results with known accuracy that can be calculated mathematically

•The sampling frame is the list from which the potential respondents are drawn

#### SAMPLING FRAME

- sampling frame which has the property that we can identify every single element and include any in our sample
- The sampling frame must be representative of the population



Why Do We Do Sampling

	Population	Sample
Size	impossible& impractical	Possible & practical
Cost	High	Less
Observed	Not all be observed	All be observed
Staff	Large size	Smaller
Time	More	Less
Effort	More	Less
Accurate	Less	More
		●Work Lighter
		•Uniform way
		Highly skilled
		More precision(well trained)

Cont. ...SAMPLES

#### **SAMPLING**

- A sample should be representative of the population
- **□** 3 factors that influence sample representativeness
- Sampling procedure
- Sample size
- Participation (response)

# Sample Size N

It is the No. of individuals that collected in the sample, denoted by  $\ensuremath{\mathsf{N}}$  .

OpenEpi for sample size calculation

#### **SAMPLING**

## Nonprobability:

-one in which the judgment of the experimenter, the methods in which the data are collected, or other factors could affect the results of the sample

## •Probability:

The chance of selection of each item of the population is known before the sample is picked

### **TYPES OF SAMPLING**

- ☐ Probability (Random) Samples
- 1. Simple random sample
- 2. Systematic random sample
- 3. Stratified random sample
- 4. Cluster sample
- 5. Multistage sample
- 6. Multiphase sample
- Non-Probability Samples
- 1) Convenience sample
- 2) Purposive sample
- 3) Quota

# **Random Sample**

- This is the most popular one,
- it is most commonly used in survey and research,
- it is a sample drawn from a population or unit in such a way that;
- every member of the population
- has the same probability of selection.
- Every member in the population having independent
- and equal chance of appearing in the sample.

# Therefore, sample now

- free of bias and it is representative to the whole population
- □ Random Sample is the simplest and the best known way to avoid bias and to be representative to the population

#### PROBABILITY SAMPLING

- Probability sampling includes:
- 1. Simple Random Sampling,
- 2. Systematic Random Sampling,
- 3. Stratified Random Sampling,
- 4. Cluster Sampling
- 5. Multistage Sampling.
- 6. Multiphase sampling

# Simple R.S.

- By using Random Digit
- Identify the population size, and
- ✓ give No. for each one of population.
- ✓ Identify the sample size
- Chose first No. blindly from the random digit .
- Decide going vertically or horizontally.
- ✓ Chose second, third, fourth...... No.
- ✓ Collect the sample size .

#### Ignore:

Repeated No.

No. larger than population size.

				IADLE 1 - KAI	כדוטוע ואוטעוי				
11164	36318	75061	37674	26320	75100	10431	20418	19228	91792
21215	91791	76831	58678	87054	31687	93205	43685	19732	08468
10438	44482	66558	37649	08882	90870	12462	41810	01806	02977
36792	26236	33266	66583	60881	97395	20461	36742	02852	50564
73944	04773	12032	51414	82384	38370	00249	80709	72605	67497
49563	12872	14063	93104	78483	72717	68714	18048	25005	04151
64208	48237	41701	73117	33242	42314	83049	21933	92813	04763
51486	72875	38605	29341	80749	80151	33835	52602	79147	08868
99756	26360	64516	17971	48478	09610	04638	17141	09227	10606
71325	55217	13015	72907	00431	45117	33827	92873	02953	85474
65285	97198	12138	53010	94601	15838	16805	61004	43516	17020
17264	57327	38224	29301	31381	38109	34976	65692	98566	29550
95639	99754	31199	92558	68368	04985	51092	37780	40261	14479
61555	76404	86210	11808	12841	45147	97438	60022	12645	62000
78137	98768	04689	87130	79225	08153	84967	64539	79493	74917
62490	99215	84987	28759	19177	14733	24550	28067	68894	38490
24216	63444	21283	07044	92729	37284	13211	37485	10415	36457
16975	95428	33226	55903	31605	43817	22250	03918	46999	98501
59138	39542	71168	57609	91510	77904	74244	50940	31553	62562
29478	59652	50414	31966	87912	87154	12944	49862	96566	48825
96155	95009	27429	72918	08457	78134	48407	26061	58754	05326
29621	66583	62966	12468	20245	14015	04014	35713	03980	03024
12639	75291	71020	17265	41598	64074	64629	63293	53307	48766
14544	37134	54714	02401	63228	26831	19386	15457	17999	18306
83403	88827	09834	11333	68431	31706	26652	04711	34593	22561
67642	05204	30697	44806	96989	68403	85621	45556	35434	09532
64041	99011	14610	40273	09482	62864	01573	82274	81446	32477
17048	94523	97444	59904	16936	39384	97551	09620	63932	03091
93039	89416	52795	10631	09728	68202	20963	02477	55494	39563
82244	34392	96607	17220	51984	10753	76272	50985	97593	34320
96990	55244	70693	25255	40029	23289	48819	07159	60172	81697
09119	74803	97303	88701	51380	73143	98251	78635	27556	20712
57666	41204	47589	78364	38266	94393	70713	53388	79865	92069
46492	61594	26729	58272	81754	14648	77210	12923	53712	87771
08433	19172	08320	20839	13715	10597	17234	39355	74816	03363
10011	75004	86054	41190	10061	19660	03500	68412	57812	57929
92420	65431	16530	05547	10683	88102	30176	84750	10115	69220
35542	55865	07304	47010	43233	57022	52161	82976	47981	46588
86595	26247	18552	29491	33712	32285	64844	69395	41387	87195
72115	34985	58036	99137	47482	06204	24138	24272	16196	04393
07428	58863	96023	88936	51343	70958	96768	74317	27176	29600
35379	27922	28906	55013	26937	48174	04197	36074	65315	12537
10982	22807	10920	26299	23593	64629	57801	10437	43965	15344
90127	33341	77806	12446	15444	49244	47277	11346	15884	28131
63002	12990	23510	68774	48983	20481	59815	67248	17076	78910
40779	86382	48454	65269	91239	45989	45389	54847	77919	41105
		18167	84631	94058	82458	15139	76856	86019	47928
43216 9616 <del>7</del> 2/7/2	64375	74108	93643	09204	98855	59051	56492	11933	64958
70975	62693	35684	72607	23026	37004	32989	24843	01128	74658
75373	02000	33507	7.2007	20020	40064	32303	2.10-10	10105	, 1000

64008 4237 41701 73117 33742 42314 83049 21933 92813 04783 51486 72875 38605 6516 17971 48478 09610 04638 17141 09227 10606 79756 26360 64516 17971 48478 09610 04638 17141 09227 10606 79756 26360 64516 17971 48478 09610 04638 17141 09227 10606 79756 7357 13015 72907 00431 45117 33827 92873 09253 88474 65285 97198 12138 53010 94001 15838 10805 61004 43516 17020 79659 9574 31199 92558 68168 04985 15092 37780 40261 14479 95639 99754 31199 92558 68168 04985 15092 37780 40261 14479 95639 99754 31199 92558 68168 04985 15092 37780 40261 14479 78137 98768 04699 87130 79225 08153 8967 64539 79493 74917 78137 98768 04699 87130 79225 08153 8967 64539 79493 74917 78137 98768 04699 37130 79225 08153 8967 64539 79493 74917 78137 98768 04699 87130 79225 37281 13211 37485 10415 36457 1878 1878 1878 1878 1878 1878 1878 18	49563	12872	14063	93104	78483	72717	68714	18048	25005	04151
51486         72875         38605         29341         80749         80151         33835         \$25602         79147         08868           99756         26360         64516         17971         48478         90610         Q483         17141         09227         10068           65285         97198         12138         53010         94601         15838         18605         61004         43516         17020           17624         57327         38224         29301         31381         38109         34976         65692         98566         29500           95639         99754         31199         92558         68368         04985         51092         37780         40261         14479           61555         76404         86210         11808         12841         45147         97438         60022         12645         62000           78137         98768         04921         79275         08153         84967         64539         74937         74914           424216         63444         21283         07044         92229         37284         13211         37485         10414         39487         19338         39467         39489         895										
99756										
17325   55217   13015   72907   00431   45117   33827   92873   02953   85474   65285   67198   12188   53010   94061   15838   1685   61004   451516   17200   17264   573277   38224   29301   31381   38109   34976   65692   98566   29550   98569   99754   31199   92558   68868   04995   51092   37780   40261   14479   61555   76404   86210   11808   12841   45147   97438   60022   12645   62000   78137   88768   04688   87130   79725   08153   84867   64539   79493   74917   62400   99215   84987   82759   19177   14733   24550   228067   68894   38490   24216   63444   21283   07044   92729   37284   13211   37485   10415   36457   15975   95428   33276   55903   31605   43817   22250   03918   46999   98501   59138   39542   71168   576609   91510   77904   74244   50940   31553   62562   29478   59652   50414   31966   87912   87154   12944   44862   96566   48825   96515   66583   67965   12468   20245   14015   04014   35713   03980   03024   12639   75291   71020   17265   41598   64074   64629   63293   53307   48766   48444   37134   54714   02401   63228   26881   19386   15457   1799   18306   18444   37134   54714   02401   63228   26881   19386   15457   1799   18306   18404   99011   14610   40273   09482   62864   01573   82274   81446   32477   17048   94523   97444   59904   16936   39344   97551   09620   63932   03991   39039   89416   52795   10631   09728   68202   20663   02477   55494   39563   64041   99011   14610   40273   09482   62864   01573   82274   81446   32477   57666   41204   47589   78364   38266   94393   70713   53388   79865   92009   55244   70693   25255   40029   23289   48819   07159   60172   81697   9119   74803   97303   88701   57386   68604   37313   98251   76635   97595   304320   309119   74803   97303   88701   57386   68604   47599   73734   39355   74816   03363   97595   97										
95639 99754 31199 92558 68868 04985 51092 37780 40261 14479 61555 76404 86210 11808 12841 45147 97438 60022 12645 62000 78137 89768 04689 87130 79225 08153 84967 64539 79943 74917 62490 99215 84897 28759 19177 14733 24550 28067 68894 38490 6921 63444 21283 07044 92729 37284 13211 37485 1015 36457 16975 95428 33226 55903 31605 43817 22250 03918 46999 98501 16975 95428 33226 55903 31605 43817 22250 03918 46999 98501 19178 14738 14738 14734 14738 14	71325	55217	13015	72907	00431	45117	33827	92873	02953	85474
995639 99754 31199 92558 68368 04985 51092 37780 40261 14479 61555 76404 86210 11808 12841 45147 97438 60022 12645 62000 78137 98768 04689 87130 79225 08133 84967 64539 79493 74917 62490 99215 84987 28759 19177 14733 24550 28667 68894 38490 24216 63444 21283 07044 92729 37284 13211 37485 10415 36457 16975 95428 33226 55503 31605 43817 22250 03918 46999 98501 16975 95428 33226 55503 31605 43817 22250 03918 46999 98501 59138 39542 71168 57609 91510 77904 74244 50940 31553 62552 29478 59652 50414 31966 87912 87154 12944 49862 96566 48825 956155 95009 27429 77218 08457 78134 48407 26061 58754 05326 23621 66583 62566 12468 20245 14015 04014 35713 03380 03024 16593 75291 71000 177655 41598 64074 64629 6323 53307 48766 14544 37134 54714 02401 63228 26831 19386 15457 17999 18306 164644 37134 54714 02401 63228 26831 19386 15457 17999 18306 164644 3991 14610 40273 09482 62864 01573 82274 81446 32477 17048 94523 97444 59904 16936 39384 97551 09620 63932 03091 193039 89416 52795 10631 09728 68202 20963 02477 55494 39563 182244 34392 96607 17220 51984 10753 76272 50985 97593 34320 196990 55244 70693 25255 40029 32889 48819 07159 60172 81697 15666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 38266 94393 70713 53388 79865 92069 157666 41204 47589 78364 4190 10061 19660 03500 68412 57812 57912 157666 41204 47589 58866 99137 44882 06204 24188 24272 11546 03483 14584 14584 14584 14584 14584 14584										
61555		57327								
78137         98768         06689         87130         79225         08153         84967         64393         79493         74917           62490         92215         84987         28759         19177         14733         24550         28067         68894         38490           16975         95428         33226         55903         31605         43817         22250         09318         46999         98501           59138         39542         71168         57609         91510         77904         74244         59940         31533         62562           29478         59652         50414         31966         87912         87154         12944         49862         96566         48825           26155         95009         27429         72918         08457         78134         48407         26061         58754         05326           28621         65683         62966         12468         20245         14015         04014         35713         03980         09024           12639         75291         71020         17265         41588         64074         64629         63293         53307         48766           12644         37134 <td></td>										
62490         99215         84897         28759         19177         14733         24550         28067         68894         38490           24216         63444         21283         07044         97279         37284         13211         37485         10415         36457           16975         95428         33226         55903         31605         43817         22250         03918         46999         98501           59138         39542         71168         57609         91510         77904         47244         50940         31553         62562           29478         59652         50414         31966         87912         87154         12944         49862         96566         48825           96155         95009         27429         72918         08457         78134         4807         26061         58734         05326           29521         66583         62666         12488         20245         14015         94014         43803         38327         14874         02401         3528         26831         13706         26652         04711         34593         25541         4803         38434         3553         2564         4814         39494<										
24216 63444 21283 07044 92779 37284 13211 37485 10415 36457 16975 95428 33226 55903 31605 43817 22250 03918 46999 98501 59138 39542 71168 57609 91510 77904 74244 50940 31553 62562 29478 59652 50414 31966 87912 87154 12944 49862 96566 48825 96155 95009 27429 72918 08457 78134 48407 26061 58754 05326 25621 66583 62566 12468 20245 14015 04014 35713 03980 03024 12639 75291 71020 17265 41598 64074 64629 63293 53307 48766 14544 37134 54714 02401 63228 26831 19386 15457 17999 11330 68431 31706 26652 04711 34593 22561 667642 05204 30697 44806 96989 68403 85621 45556 35434 09532 64041 99011 14610 40273 09482 62864 01573 82274 81446 32477 17048 94523 97444 59904 16936 39384 97551 09620 63932 03091 93039 89416 52795 10631 09728 68202 20963 02477 55494 39563 82244 34392 96607 17220 51984 10753 76327 250985 97593 34320 96990 55244 70693 25255 40029 23289 48819 07159 60172 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27556 20712 81697 09119 74803 97303 88701 51380 73143 98251 78635 27566 41204 47589 78364 38266 94393 37113 93255 74816 03363 3712 87771 08433 19172 08320 08393 13715 10597 17244 39355 74816 03363 37142 87771 08433 19172 08320 08545 28565 94594 39395 54484 77710										
16975         95428         33226         55903         31605         43817         22250         03918         46999         98501           59138         39542         71168         57609         91510         77904         76244         50940         31553         62562           29478         59652         50414         31966         87912         87154         12944         49862         96566         48825           96155         95009         27429         72918         08457         78134         48407         26061         58754         05326           29621         66683         62966         12468         20245         14015         04014         35713         03980         03024           12639         75291         71020         17265         41598         64074         64629         63293         53307         4876           4503         88207         70834         14333         68411         31706         26652         04711         34593         22561           67642         05204         30697         44806         96989         68403         85621         45556         35434         09532           64041         99011										
59138         39542         71168         57609         91510         77904         74244         59640         31553         62562           29478         59652         50414         31966         87912         87154         12944         49862         96566         48825           96155         95009         27429         72918         08457         78134         48407         26061         58754         05326           29621         66583         62966         12468         20245         14015         04014         35713         03980         03024           12639         75291         71020         17265         44588         64074         64629         63293         53307         48766           14544         37134         54714         02401         63228         26831         19386         15457         17999         18306           83403         88827         9834         11333         68431         31936         15457         17999         18306           64041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         9523         97444										
29478         59652         50414         31966         87912         87154         12944         49862         96566         48825           96155         59509         27429         72918         08457         78134         48407         26061         58754         05326           29621         66583         62966         12468         20245         14015         04014         35713         03380         03024           16593         75291         71020         17765         41598         64074         64629         63293         53307         48766           14544         37134         54714         02401         63228         26831         19386         15457         17999         18306           87403         88827         09834         11333         68431         31706         26652         04711         34593         27561           67642         05204         30697         44806         9689         68403         85621         45556         35434         09532           46041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         94523 <td></td>										
96155 95009 27429 72918 08457 78134 48407 26061 58754 05326 29621 66583 62966 12468 20245 14015 04014 35713 03980 03024 12639 75291 71020 17265 41598 64074 64629 63293 53307 48766 14544 37134 54714 02401 63228 26831 19386 15457 17999 18306 83403 88877 09834 11333 68241 31706 76652 04711 34593 27561 67642 05204 30697 44806 96989 68403 85621 45556 35434 09532 64041 99011 14610 40273 09482 62864 01573 82274 81446 32477 17048 94523 97444 59904 16936 39384 97551 09620 63392 03091 93039 89416 52795 10631 09728 68202 20963 02477 55494 39563 82244 34392 96607 17220 51984 10753 76272 50985 97593 34320 969919 74803 97303 88701 51380 73143 98251 78635 27556 20712 57666 41204 47589 78364 38266 94393 70713 53388 79865 92069 46492 61594 26729 58272 81754 14648 77210 12923 53712 87771 08433 19172 08320 20839 13715 10597 17234 39355 74816 03363 10011 75004 86054 41190 10061 19660 03500 68412 57812 57929 97428 58863 96023 88396 51343 70958 88595 2647 18552 29491 33712 32285 64844 69395 41387 87512 57929 97428 58863 96023 88396 51343 70958 97593 34320 97462 58856 97304 47010 43233 57002 52161 82976 47981 45688 86595 2647 18552 29491 33712 32285 64844 69395 41387 87159 57215 34985 58036 99137 47482 06204 24138 24272 16196 04393 07428 58863 96023 88396 51343 70958 97580 110437 47482 58863 96023 88396 51343 70958 97580 110437 47482 58863 96023 88396 51343 70958 97580 110437 43965 15344 99152 33341 77806 12446 15444 49244 47277 11346 15884 28131 67502 12990 23510 68774 48983 20481 59815 59815 67248 17076 78910 4079 86382 48454 65269 91339 45989 45389 54847 77919 41105 43216 12608 18167 84454 65269 91239 45989 45389 54847 77919 41105 43216 12608 18167 84459 61209 43865 59051 32693 35684 72607 23026 37004 32989 24843 01128 74658 74658 770975 62693 35684 72607 23026 37004 32989 24843 01128 74658 74658 770975 62693 35684 72607 23026 37004 32989 24843 01128 74658 74658 770975 62693 35684 72607 23026 37004 32989 24843 01128 74658 770975 62693 35684 72607 23026 37004 32989 24843 01128 74658 770975 62693 35684 72607 23026 37004 32989 24843										
29621         66583         62966         12488         20245         14015         04014         35713         03980         03024           12639         75291         71020         17265         41598         64074         64629         63293         53307         48766           14544         37134         54714         02401         63228         26831         19386         15457         17999         18306           83403         88827         09834         11333         68431         31706         26652         04711         34593         22561           67642         05204         30697         44806         96989         68403         85621         45556         35434         09532           64041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         94523         97444         59904         16936         39384         97551         09620         63932         30391           93039         89416         52795         10631         09728         68202         20963         02477         55494         39563           82244         33932 <td></td>										
12639   75291   71020   12765   41598   64074   64629   63293   53307   48766   14544   37134   54714   02401   63228   26831   19386   15457   17999   18306   83403   88877   09834   11333   68431   31706   26652   04711   34593   72561   67642   05204   30697   44806   96989   68403   85621   45556   35434   09532   64041   99011   14610   40273   09482   62864   01573   82274   81446   32477   17048   94523   97444   59904   16936   39384   97551   09620   63932   03091   93039   89416   52795   10631   09728   68202   20963   02477   55494   39563   82244   34392   96607   17220   51984   10753   76272   50985   97593   34320   96990   55244   70693   25255   40029   23289   48819   07159   60172   81697   09119   74803   97303   88701   51380   73143   98251   78635   27556   20712   57666   41204   47589   78364   38266   94393   70713   53388   79655   92069   46492   61594   26729   58272   81754   14648   77210   12923   53712   87771   08433   19172   08320   20839   13715   10597   17234   39355   74816   03363   10172   05431   16530   05547   10683   88102   30176   84750   10115   69220   35542   55865   07304   47010   43233   57022   52161   82976   47981   46588   86595   26247   18552   29491   33712   32285   64844   69395   41187   27176   29600   35379   27922   28906   55013   26937   48174   04197   36074   65315   12537   10982   22807   10920   26299   23593   64629   57801   10437   43965   15344   90127   33341   77806   12446   15444   49244   47277   11346   15884   28131   63002   12990   23510   68774   48983   20481   59815   67248   17076   78910   40779   86382   48454   65269   91239   45989   45389   54847   77919   41105   43216   12608   18167   84631   94058   82458   15139   76856   86019   47928   96167   64375   74108   93643   09024   98855   59051   56492   11933   64958   96167   64375   74108   93643   09024   98855   59051   56492   11933   64958   96167   64375   74108   93643   09024   98855   59051   56492   11933   64958   96167   64375   74108   93643   0902										
14544         37134         54714         02401         63228         26831         19386         15457         17999         18306           67642         05204         30697         44806         96989         68403         85621         45556         35434         09532           64041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         94523         97444         59904         16936         39384         97551         09620         63932         03091           82244         34392         96607         17220         51984         10753         76272         50985         97593         34320           96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           57666         41204         47589         78364         38266         94393         70713         53388         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           57666         41204 <td></td>										
83403         8887         09844         11333         68431         31706         26652         04711         34593         22561           67642         05204         30697         44806         96989         68403         85621         45556         35434         09532           64041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         94523         97444         59904         16936         39384         97551         09620         63932         03091           93039         89416         52795         10631         09728         68202         20963         02477         55494         39563           82244         34392         96607         17220         51984         10753         76272         50985         97593         34320           96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           99119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204 <td></td>										
64041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         94523         97444         59904         16936         39384         97551         09620         63932         03091           82244         34392         96607         17220         51984         10753         76272         50985         97593         34320           96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           09119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204         47589         78364         38266         94393         70713         5338         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004 <td></td>										
64041         99011         14610         40273         09482         62864         01573         82274         81446         32477           17048         94523         97444         59904         16936         39384         97551         09620         63932         03091           82244         34392         96607         17220         51984         10753         76272         50985         97593         34320           96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           09119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204         47589         78364         38266         94393         70713         5338         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004 <td>67642</td> <td>05204</td> <td>30697</td> <td>44806</td> <td>96989</td> <td>68403</td> <td>85621</td> <td>45556</td> <td>35434</td> <td>09532</td>	67642	05204	30697	44806	96989	68403	85621	45556	35434	09532
93039         89416         52795         10631         09728         68202         20963         02477         55494         39563           82244         34392         96607         17220         51984         10753         76272         50985         97593         34320           96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           09119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204         47589         78364         38266         94393         70713         53388         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431 <td></td>										
93039         89416         52795         10631         09728         68202         20963         02477         55494         39563           82244         34392         96607         17220         51984         10753         76272         50985         97593         34320           96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           09119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204         47589         78364         38266         94393         70713         53388         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431 <td>17048</td> <td>94523</td> <td>97444</td> <td>59904</td> <td>16936</td> <td>39384</td> <td>97551</td> <td>09620</td> <td>63932</td> <td>03091</td>	17048	94523	97444	59904	16936	39384	97551	09620	63932	03091
96990         55244         70693         25255         40029         23289         48819         07159         60172         81697           09119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204         47589         78364         38266         94393         70713         53388         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431         16530         05547         10683         88102         30176         84750         10115         69220           35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247 <td>93039</td> <td>89416</td> <td>52795</td> <td>10631</td> <td>09728</td> <td>68202</td> <td>20963</td> <td>02477</td> <td>55494</td> <td>39563</td>	93039	89416	52795	10631	09728	68202	20963	02477	55494	39563
09119         74803         97303         88701         51380         73143         98251         78635         27556         20712           57666         41204         47589         78364         38266         94393         70713         53388         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431         16530         05547         10683         88102         30176         84750         10115         69220           35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247         18552         29491         33712         32285         64844         69395         41387         87195           72115         34985 <td>82244</td> <td>34392</td> <td>96607</td> <td>17220</td> <td>51984</td> <td>10753</td> <td>76272</td> <td>50985</td> <td>97593</td> <td>34320</td>	82244	34392	96607	17220	51984	10753	76272	50985	97593	34320
57666         41204         47589         78364         38266         94393         70713         53388         79865         92069           46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431         16530         05547         10683         88102         30176         84750         10115         69220           35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247         18552         29491         33712         32285         64844         69395         41387         87195           72115         34985         58036         99137         47482         06204         24138         24272         16196         04393           97428         58863 <td>96990</td> <td>55244</td> <td>70693</td> <td>25255</td> <td>40029</td> <td>23289</td> <td>48819</td> <td>07159</td> <td>60172</td> <td>81697</td>	96990	55244	70693	25255	40029	23289	48819	07159	60172	81697
46492         61594         26729         58272         81754         14648         77210         12923         53712         87771           08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431         16530         05547         10683         88102         30176         84750         10115         69220           35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247         18552         29491         33712         32285         64844         69395         41387         87195           72115         34985         58036         99137         47482         06204         24138         24272         16196         04393           07428         58863         96023         88936         51343         70958         96768         74317         27176         29600           35379         27922 <td>09119</td> <td>74803</td> <td>97303</td> <td>88701</td> <td>51380</td> <td>73143</td> <td>98251</td> <td>78635</td> <td>27556</td> <td>20712</td>	09119	74803	97303	88701	51380	73143	98251	78635	27556	20712
08433         19172         08320         20839         13715         10597         17234         39355         74816         03363           10011         75004         86054         41190         10061         19660         03500         68412         57812         57929           92420         65431         16530         05547         10683         88102         30176         84750         10115         69220           35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247         18552         29491         33712         32285         64844         69395         41387         87195           72115         34985         58036         99137         47482         06204         24138         24272         16196         04393           07428         58863         96023         88936         51343         70958         96768         74317         27176         29600           35379         27922         28906         55013         26937         48174         04197         36074         65315         12537           10982         22807 <td>57666</td> <td>41204</td> <td>47589</td> <td>78364</td> <td>38266</td> <td>94393</td> <td>70713</td> <td>53388</td> <td>79865</td> <td>92069</td>	57666	41204	47589	78364	38266	94393	70713	53388	79865	92069
10011       75004       86054       41190       10061       19660       03500       68412       57812       57929         92420       65431       16530       05547       10683       88102       30176       84750       10115       69220         35542       55865       07304       47010       43233       57022       52161       82976       47981       46588         86595       26247       18552       29491       33712       32285       64844       69395       41387       87195         72115       34985       58036       99137       47482       06204       24138       24272       16196       04393         07428       58863       96023       88936       51343       70958       96768       74317       27176       29600         35379       27922       28906       55013       26937       48174       04197       36074       65315       12537         10982       22807       10920       26299       23593       64629       57801       10437       43965       15344         90127       33341       77806       12446       15444       49244       47277       11346       15884	46492	61594	26729	58272	81754	14648	77210	12923	53712	87771
92420         65431         16530         05547         10683         88102         30176         84750         10115         69220           35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247         18552         29491         33712         32285         64844         69395         41387         87195           72115         34985         58036         99137         47482         06204         24138         24272         16196         04393           07428         58863         96023         88936         51343         70958         96768         74317         27176         29600           35379         27922         28906         55013         26937         48174         04197         36074         65315         12537           10982         22807         10920         26299         23593         64629         57801         10437         43965         15344           90127         33341         77806         12446         15444         49244         47277         11346         15884         28131           63002         12990 <td>08433</td> <td>19172</td> <td>08320</td> <td>20839</td> <td>13715</td> <td>10597</td> <td>17234</td> <td>39355</td> <td>74816</td> <td>03363</td>	08433	19172	08320	20839	13715	10597	17234	39355	74816	03363
35542         55865         07304         47010         43233         57022         52161         82976         47981         46588           86595         26247         18552         29491         33712         32285         64844         69395         41387         87195           72115         34985         58036         99137         47482         06204         24138         24272         16196         04393           07428         58863         96023         88936         51343         70958         96768         74317         27176         29600           35379         27922         28906         55013         26937         48174         04197         36074         65315         12537           10982         22807         10920         26299         23593         64629         57801         10437         43965         15344           90127         33341         77806         12446         15444         49244         47277         11346         15884         28131           63002         12990         23510         68774         48983         20481         59815         67248         17076         78910           40779         86382 <td>10011</td> <td>75004</td> <td>86054</td> <td>41190</td> <td>10061</td> <td>19660</td> <td>03500</td> <td>68412</td> <td>57812</td> <td>57929</td>	10011	75004	86054	41190	10061	19660	03500	68412	57812	57929
86595       26247       18552       29491       33712       32285       64844       69395       41387       87195         72115       34985       58036       99137       47482       06204       24138       24272       16196       04393         07428       58863       96023       88936       51343       70958       96768       74317       27176       29600         35379       27922       28906       55013       26937       48174       04197       36074       65315       12537         10982       22807       10920       26299       23593       64629       57801       10437       43965       15344         90127       33341       77806       12446       15444       49244       47277       11346       15884       28131         63002       12990       23510       68774       48983       20481       59815       67248       17076       78910         40779       86382       48454       65269       91239       45989       45389       54847       77919       41105         43216       12608       18167       84631       94058       82458       15139       76856       86019	92420	65431	16530	05547	10683	88102	30176	84750	10115	69220
86595       26247       18552       29491       33712       32285       64844       69395       41387       87195         72115       34985       58036       99137       47482       06204       24138       24272       16196       04393         07428       58863       96023       88936       51343       70958       96768       74317       27176       29600         35379       27922       28906       55013       26937       48174       04197       36074       65315       12537         10982       22807       10920       26299       23593       64629       57801       10437       43965       15344         90127       33341       77806       12446       15444       49244       47277       11346       15884       28131         63002       12990       23510       68774       48983       20481       59815       67248       17076       78910         40779       86382       48454       65269       91239       45989       45389       54847       77919       41105         43216       12608       18167       84631       94058       82458       15139       76856       86019	35542	55865	07304	47010	43233			82976	47981	46588
72115       34985       58036       99137       47482       06204       24138       24272       16196       04393         07428       58863       96023       88936       51343       70958       96768       74317       27176       29600         35379       27922       28906       55013       26937       48174       04197       36074       65315       12537         10982       22807       10920       26299       23593       64629       57801       10437       43965       15344         90127       33341       77806       12446       15444       49244       47277       11346       15884       28131         63002       12990       23510       68774       48983       20481       59815       67248       17076       78910         40779       86382       48454       65269       91239       45989       45389       54847       77919       41105         43216       12608       18167       84631       94058       82458       15139       76856       86019       47928         96167       64375       74108       93643       09204       98855       59051       56492       11933	86595	26247	18552	29491	33712	32285	64844	69395	41387	87195
07428     58863     96023     88936     51343     70958     96768     74317     27176     29600       35379     27922     28906     55013     26937     48174     04197     36074     65315     12537       10982     22807     10920     26299     23593     64629     57801     10437     43965     15344       90127     33341     77806     12446     15444     49244     47277     11346     15884     28131       63002     12990     23510     68774     48983     20481     59815     67248     17076     78910       40779     86382     48454     65269     91239     45989     45389     54847     77919     41105       43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658	72115	34985	58036	99137			24138	24272	16196	04393
35379     27922     28906     55013     26937     48174     04197     36074     65315     12537       10982     22807     10920     26299     23593     64629     57801     10437     43965     15344       90127     33341     77806     12446     15444     49244     47277     11346     15884     28131       63002     12990     23510     68774     48983     20481     59815     67248     17076     78910       40779     86382     48454     65269     91239     45989     45389     54847     77919     41105       43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658										
10982     22807     10920     26299     23593     64629     57801     10437     43965     15344       90127     33341     77806     12446     15444     49244     47277     11346     15884     28131       63002     12990     23510     68774     48983     20481     59815     67248     17076     78910       40779     86382     48454     65269     91239     45989     45389     54847     77919     41105       43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658										
90127     33341     77806     12446     15444     49244     47277     11346     15884     28131       63002     12990     23510     68774     48983     20481     59815     67248     17076     78910       40779     86382     48454     65269     91239     45989     45389     54847     77919     41105       43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658										
63002     12990     23510     68774     48983     20481     59815     67248     17076     78910       40779     86382     48454     65269     91239     45989     45389     54847     77919     41105       43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658										
40779     86382     48454     65269     91239     45989     45389     54847     77919     41105       43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658										
43216     12608     18167     84631     94058     82458     15139     76856     86019     47928       96167     64375     74108     93643     09204     98855     59051     56492     11933     64958       70975     62693     35684     72607     23026     37004     32989     24843     01128     74658										
96167 64375 74108 93643 09204 98855 59051 56492 11933 64958 70975 62693 35684 72607 23026 37004 32989 24843 01128 74658										
70975 62693 35684 72607 23026 37004 32989 24843 01128 74658										
6361 <u>EZ</u> ///ZUZ3 016/3 233/0 /3/34 23030 40204 60333 4/234 40133 69916										
	03012/7/7	2023 010/3	25570	/5/54	29090	40204	00333	4/254	40133	09910

#### Cont. ... SIMPLE RANDOM SAMPLING

- Applicable when population is small, homogeneous & readily available
- •All subsets of the frame are given an equal probability. Each element of the frame thus has an equal probability of selection.
- •It provides for greatest number of possible samples. This is done by assigning a number to each unit in the sampling frame.
- •A table of random number or lottery system is used to determine which units are to be selected.

# Advantages

- -Estimates are easy to calculate.
- -Simple

### Disadvantages

- -If sampling frame large, this method is impracticable.
- –Need complete sampling frame.
- -Minority subgroups of interest in population may not be present in sample in sufficient numbers for study.

# How to draw a simple random sample example

The following example describes the drawing of a sample of 20 individuals from a population of 80 using random number tables

Give every individual a number (80 individuals)

Use five-digit random numbers table (these may be found in most statistics textbooks) – the table opposite shows only the last 2 digits from the left of the 5 digit random numbers from a 5 digit random table, this is to avoid cluttering

Close your eyes and put your pen on one of the numbers in the random number table, for example 45. This will be your starting point

Start with the selected number and choose a direction (up, down, left or right)

Record the numbers that appear in the table, moving in the chosen direction until you have selected 20 numbers which lie between 1 and 80

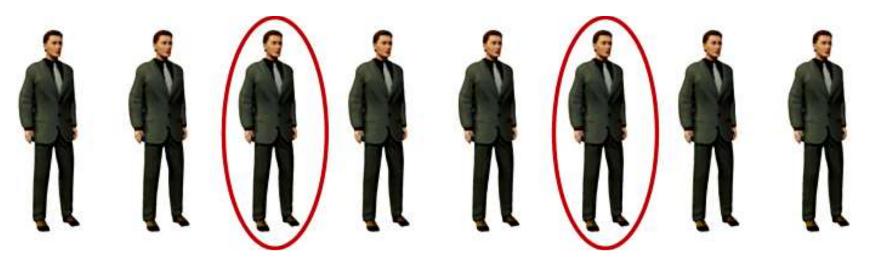
Any numbers above 80, and numbers which have already been selected are ignored

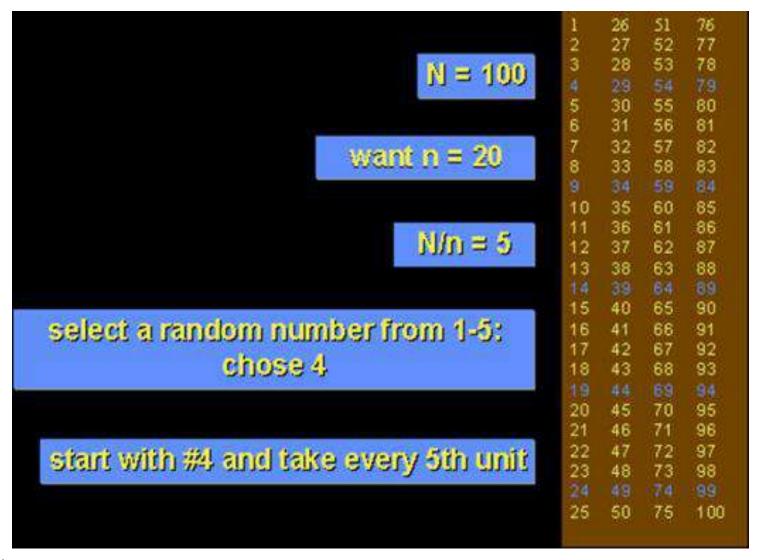
Graphics by R. Vijayan

Random number table						
25	19	64	82	84		
23	02	41	46	01		
55	85	66	96	28		
68	45	19	69	59		
69	31	46	29	85		
37	31	61	28	98		
66	42	19	24	91		
33	65	78	12	35		
76	32	06	19	35		
43	33	42	02	59		
28	31	93	43	94		
97	19	21	53	20		

- •Sampling with system.
  - By using predefine system:
- Identify population size .
- Identify sample size .
- Identify predefine system we need 10th 8th every kth element
- In this case, k=(population size/sample size).
- Chose first No. By using random digit .
- It is important that the starting point is not automatically the first in the list, but is instead randomly chosen from
- within the first to the kth element in the list.
- Use predefine system to collect 2nd 3rd .... K No.
- then selecting elements at regular intervals through that ordered list.
- Collect the sample size

•All elements have the same probability of selection (in the example given, one in ten). It is not 'simple random sampling' because different subsets of the same size have different selection probabilities - e.g. the set {4,14,24,...,994} has a one-in-ten probability of selection, but the set {4,13,24,34,...} has zero probability of selection





#### •ADVANTAGES:

- -Sample easy to select
- -Suitable sampling frame can be identified easily
- -Sample evenly spread over entire reference population

#### • DISADVANTAGES:

- -Sample may be biased if hidden periodicity in population coincides with that of selection.
- Difficult to assess precision of estimate from one survey.

# Thank Notes

#### STRATIFIED SAMPLING

#### By using well define stratum

- •Where population enclose, a number of distinct categories, the frame can be organized into separate "strata.
- "Each stratum is then sampled as an independent sub-population, out of which individual elements can be randomly selected.
- Every unit in a stratum has same chance of being selected.
- •Using same sampling fraction for all strata ensures proportionate representation in the sample.
- •Adequate representation of minority subgroups of interest can be ensured by stratification & varying sampling fraction between strata as required.
- •Finally, since each stratum is treated as an independent population, different sampling approaches can be applied to different strata.