NON-PARAMETRIC TEST

Statistical tests fall into two categories:

(i) Parametric tests

(ii) Non-parametric tests

The parametric tests make the following assumptions

- the population is normally distributed;
- homogeneity of variance

If any or all of these assumptions are untrue

- then the results of the test may be invalid.
- it is safest to use a **non-parametric test.**

ADVANTAGES OF NON-PARAMETRIC TESTS

- If the sample size is small there is no alternative
- If the data is nominal or ordinal
- These tests are much easier to apply

DISADVANTAGES OF NON-PARAMETRIC TESTS

i) Discard information by converting to ranks

ii) Parametric tests are more powerful

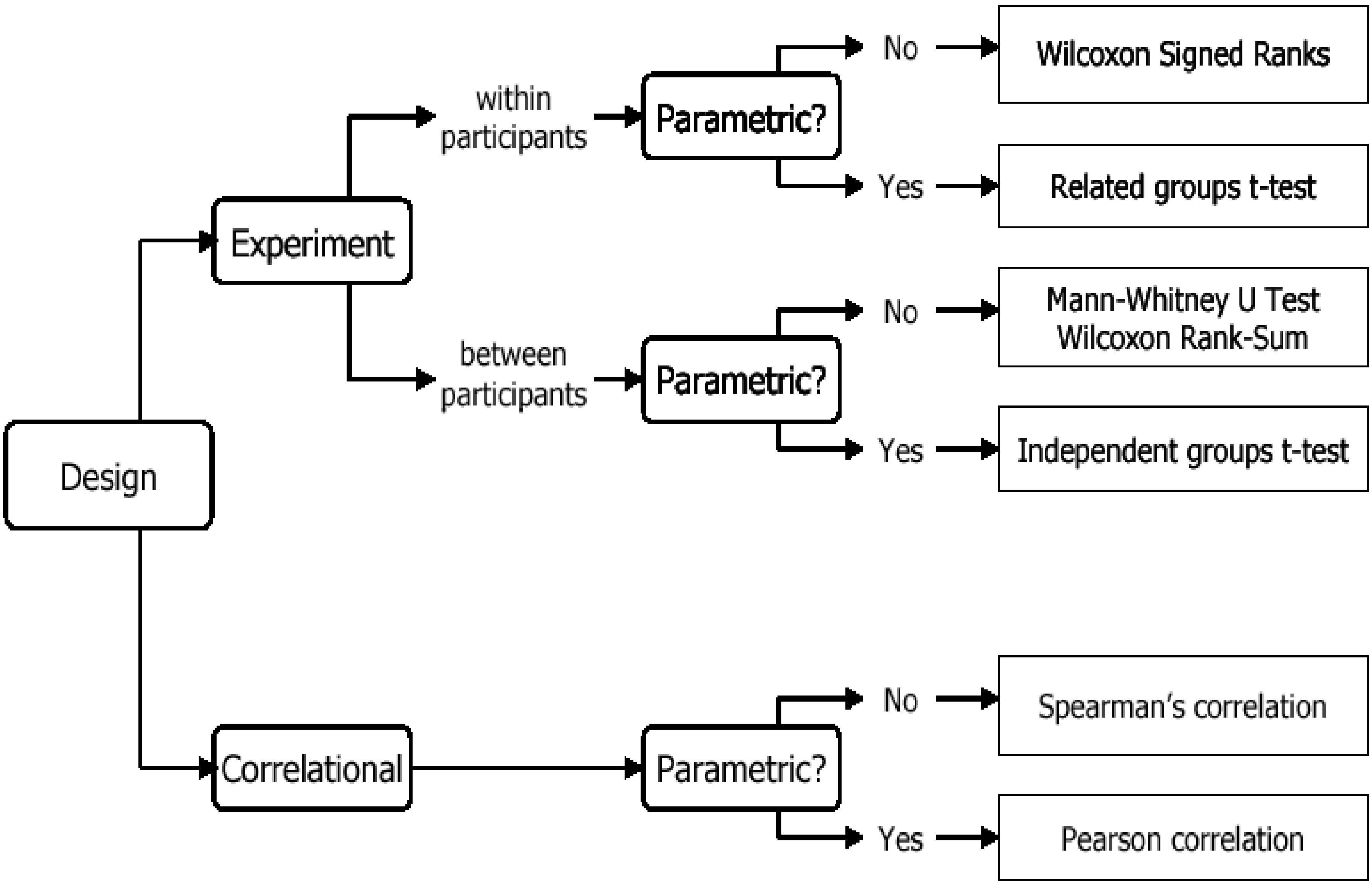
iii) Tables of critical values may not be easily available.

iv) It is merely for testing of hypothesis and no confidence limits could be calculated.

Non-parametric tests

- Note: When valid, use parametric
- Commonly used
  - Wilcoxon signed-rank test
  - Wilcoxon rank-sum test
  - Spearman rank correlation
  - Chi square etc.
- Useful for non-normal data
- If possible use some transformation
- If normalization not possible
- Note: CI interval -difficult/impossible

Which statistical test [redacted]



Wilcoxon signed rank test

- To test difference between paired data

EXAMPLE

Patient	Hours of sleep	
	Drug	Placebo
1	6.1	5.2
2	7.0	7.9
3	8.2	3.9
4	7.6	4.7
5	6.5	5.3
6	8.4	5.4
7	6.9	4.2
8	6.7	6.1
9	7.4	3.8
10	5.8	6.3

Null Hypothesis: Hours of sleep are the same using placebo & the drug

STEP 1

- **Exclude any differences which are zero**
- **Ignore their signs**
- **Put the rest of differences in ascending order**
- **Assign them ranks**
- **If any differences are equal, average their ranks**

STEP 2

- **Count up the ranks of +ives as T_+**

- **Count up the ranks of –ives as T_-**

STEP 3

- If there is no difference between drug (T_+) and placebo (T_-), then T_+ & T_- would be similar

- If there is a difference

  one sum would be much smaller and

  the other much larger than expected

- The larger sum is denoted as T

- T = larger of T_+ and T_-

STEP 4

- **Compare the value obtained with the critical values (5%, 2% and 1%) in table**

- **N is the number of differences that were ranked (not the total number of differences)**

- **So the zero differences are excluded**

Patient	Hours of sleep		Difference	Rank Ignoring sign
	Drug	Placebo		
1	6.1	5.2	0.9	3.5*
2	7.0	7.9	-0.9	3.5*
3	8.2	3.9	4.3	10
4	7.6	4.7	2.9	7
5	6.5	5.3	1.2	5
6	8.4	5.4	3.0	8
7	6.9	4.2	2.7	6
8	6.7	6.1	0.6	2
9	7.4	3.8	3.6	9
10	5.8	6.3	-0.5	1

3rd & 4th ranks are tied hence averaged; T= larger of T_+ (50.5) and T_- (4.5)

Here, calculated value of T= 50.5; tabulated value of T= 47 (at 5%)

significant at 5% level indicating that the drug (hypnotic) is more effective than placebo

Wilcoxon rank sum test

- **To compare two groups**

- **Consists of 3 basic steps**

Non-smokers (n=15)	Heavy smokers (n=14)
Birth wt (Kg)	Birth wt (Kg)
3.99	3.18
3.79	2.84
3.60*	2.90
3.73	3.27
3.21	3.85
3.60*	3.52
4.08	3.23
3.61	2.76
3.83	3.60*
3.31	3.75
4.13	3.59
3.26	3.63
3.54	2.38
3.51	2.34
2.71	

Null Hypothesis: Mean birth weight is same between non-smokers & smokers

Step 1

- Rank the data of both the groups in ascending order

- If any values are equal, average their ranks

Step 2

- Add up the ranks in the group with smaller sample size

- If the two groups are of the same size either one may be picked

- T= sum of ranks in the group with smaller sample size

Step 3

- Compare this sum with the critical ranges given in table
- Look up the rows corresponding to the sample sizes of the two groups
- A range will be shown for the 5% significance level

Non-smokers (n=15)		Heavy smokers (n=14)	
Birth wt (Kg)	Rank	Birth wt (Kg)	Rank
3.99	27	3.18	7
3.79	24	2.84	5
3.60*	18	2.90	6
3.73	22	3.27	11
3.21	8	3.85	26
3.60*	18	3.52	14
4.08	28	3.23	9
3.61	20	2.76	4
3.83	25	3.60*	18
3.31	12	3.75	23
4.13	29	3.59	16
3.26	10	3.63	21
3.54	15	2.38	2
3.51	13	2.34	1
2.71	3		
	Sum=272		**Sum=163**

*** 17, 18 & 19are tied hence the ranks are averaged**

Hence caculated value of T = 163; tabulated value of T (14,15) = 151

Mean birth weights are not same for non-smokers & smokers they are significantly different

Spearman's Rank Correlation Coefficient

- based on the ranks of the items rather than actual values.
- can be used even with the actual values

Examples

- to know the correlation between honesty and wisdom of the boys of a class.
- It can also be used to find the degree of agreement between the judgements of two examiners or two judges.

R (Rank correlation coefficient) = $1 - \dfrac{6\sum D^2}{N\left(N^2 - 1\right)}$

D = Difference between the ranks of two items

N = The number of observations.

Note: **$-1 \le R \le 1$.**

i) When **R = +1** Perfect positive correlation or complete agreement in the same direction

ii) When **R = -1** Perfect negative correlation or complete agreement in the opposite direction.

iii) When **R = 0** No Correlation.

Computation

i. Give ranks to the values of items.

Generally the item with the highest value is ranked 1 and then the others are given ranks 2, 3, 4, ... according to their values in the decreasing order.

ii. Find the difference $D = R_1 - R_2$

where R_1 = Rank of x and R_2 = Rank of y

Note that $\Sigma D = 0$ (always)

iii. Calculate D^2 and then find ΣD^2

iv. Apply the formula.

If there is a tie between two or more items.

Then give the average rank. If m be the number of items of equal rank, the factor $1(m^3-m)/12$ is added to ΣD^2. If there is more than one such case then this factor is added as many times as the number of such cases, then

[redacted]

Student No.	Rank in Maths (R_1)	Rank in Stats (R_2)	$R_1 - R_2$ D	$(R_1 - R_2)^2$ D^2
1	1	3	-2	4
2	3	1	2	4
3	7	4	3	9
4	5	5	0	0
5	4	6	-2	4
6	6	9	-3	9
7	2	7	-5	25
8	10	8	2	4
9	9	10	-1	1
10	8	2	6	36
N = 10			$\Sigma D = 0$	$\Sigma D^2 = 96$

[redacted]