Exercise 8C

1. Ten athletes ran a fixed 200m distance on successive days, firstly on a synthetic athletic track and then on a conventional cinder track. The decision whether each athlete ran on cinder first or synthetic first was made at random. The results in seconds were as follows:

Athlete	1	2	3	4	5	6	7	8	9	10
Synthetic	26.5	25.8	27.2	28.1	25.6	25.5	28.8	27.1	24.1	26.6
Cinder	26.6	26.1	27.4	28.0	25.8	26.6	29.1	27.0	24.8	26.8

Carry out a sign test, at the 5% significance level, to determine whether the nature of the surface influences athletes' performance in the 200m.

2. Ten psychology students carried out an experiment. They wished to test whether the ability to perform a simple control task is influenced by the presence of an audience.
Each student carried out the task on their own first and measured the time taken. Then, each student performed the same task again in front of an audience. The time results (seconds) were:

Student	A	B	C	D	E	F	G	H	I	J
Alone	45.4	48.2	47.5	49.1	54.3	45.5	58.2	47.1	54.3	46.8
Audience	46.7	51.2	47.8	48.0	55.8	46.6	59.1	47.0	54.8	49.6

(a) Explain why this is known as a paired test
(b) Explain how experimental error is reduced by using paired design
(c) Carry out a sign test at the 5% significance level to determine whether students take longer to perform this task when an audience is present.
(d) What problem arises in interpreting the results of this experiment? How could the design have been improved in order to avoid this problem?

3. Pairs of twins, where each twin suffers from moderate eczema, are recruited for the trial of a new skin preparation. The trial is a double blind trial in which the twin selected at random to be in the control group is given a placebo. The percentage improvement after 4 weeks of treatment was assessed with the following results:

Twin	1	2	3	4	5	6	7	8
Placebo	16	10	16	22	22	24	24	11
New Prep	21	16	20	25	20	28	26	15

Carry out a sign test, at the 5% significance level, to determine whether the new preparation appears to result in a twin having a higher percentage improvement of their eczema.

4. Identical programs were run on two different makes of personal computers and the load times (seconds) on each machine, for each program were noted
Carry out a distribution-free test on this paired data to determine whether there is any evidence of a difference between the two personal computers. Use the sign test at the 5% significance level.

Program	1	2	3	4	5	6	7	8	9	10	11	12
PC A	37	77	49	26	23	16	15	11	45	25	9	55
PC B	30	66	47	22	20	14	17	13	43	31	7	41

5. On the 2nd July 1980 the incoming mail in each of 12 selected towns was randomly divided into two similar lots prior to sorting. In each town one lot was then sorted by the traditional sorting method, the other by a new Electronic Post Code Sensor Device (EPCSD). The times taken, in hours, to complete these jobs are recorded below

Town	A	B	D	C	E	F	G	H	I	J	K	L
Hand Sort	4.3	4.1	5.6	4.0	5.9	4.9	4.3	5.4	5.6	5.2	6.1	4.7
EPCSE Sort	3.7	5.3	4.5	3.1	4.8	5.0	3.5	4.9	4.6	4.1	5.7	3.5

Use the sign test and the 5% level of significance to test the null hypothesis of no difference in the times against the alternative hypothesis that the EPCSD method is quicker.
What further information would you require before making a decision whether or not to change over to the new EPCSD system?