

Non-parametric Tests 2 MS

Q1.

5(a)	Underlying distribution or population of differences is unknown Underlying distributions or population of scores for both X and Y are unknown	B1	Not known to be normal. Condone 'scores for X and Y cannot be assumed to be normally distributed'.
		1	
5(b)	H_0 : difference of population medians = 0	B1	Correct hypotheses, allow m but not μ or mean.
	H_1 : difference of population median $\neq 0$	B1	'population' included.
	Diff: 4 -1 -21 3 -7 -9 -5 8 -10 -12 -11	M1	Differences, allow one error.
	Rank: 3 -1 -11 2 -5 -7 -4 6 -8 -10 -9	M1	Signed ranks, allow one sign error.
	$[Q=-55,]P=11$	A1	$P = 11$
	Critical tabular value = 13 '11' < 13 so reject H_0	M1	Comparison with 13 and correct ft conclusion.
	Sufficient evidence of a preference for one of the uniforms OE	A1	Correct conclusion, in context, following correct work, except possibly second B1. Level of uncertainty in language is used.
	7		

Q2.

2	H_0 : difference in population medians = 0 ($m_a = m_b$)	B1	Correct hypotheses, allow m_d . Do not allow μ or mean.
	H_1 : difference in population medians $\neq 0$ ($m_a \neq m_b$)	B1	'population' included.
	Diff: 12 -14 -1 3 -13 8 -5 15 6	M1	Allow one error.
	Rank: 6 -8 -1 2 -7 5 -3 9 4	M1	Allow one error.
	Smaller sum 19	A1	(Other sum is 26.)
	Critical tabular value = 8 '19' > 8 so accept H_0	M1	Comparison with 8 and correct FT conclusion.
	There is insufficient evidence that marks differ	A1	Correct conclusion, in context, following correct work, except possibly the hypotheses. Level of uncertainty in language is used.
	7		

Non-parametric Tests 2 MS

Q3.

6	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr><td>51</td><td>1</td><td>72</td><td>3</td></tr> <tr><td>55</td><td>2</td><td>86</td><td>5</td></tr> <tr><td>75</td><td>4</td><td>170</td><td>10</td></tr> <tr><td>98</td><td>6</td><td>175</td><td>11</td></tr> <tr><td>137</td><td>7</td><td>220</td><td>12</td></tr> <tr><td>152</td><td>8</td><td>260</td><td>17</td></tr> <tr><td>167</td><td>9</td><td>262</td><td>18</td></tr> <tr><td>235</td><td>13</td><td>302</td><td>19</td></tr> <tr><td>238</td><td>14</td><td>311</td><td>20</td></tr> <tr><td>242</td><td>15</td><td>320</td><td>21</td></tr> <tr><td>256</td><td>16</td><td>333</td><td>22</td></tr> <tr><td></td><td></td><td>351</td><td>23</td></tr> </table>	51	1	72	3	55	2	86	5	75	4	170	10	98	6	175	11	137	7	220	12	152	8	260	17	167	9	262	18	235	13	302	19	238	14	311	20	242	15	320	21	256	16	333	22			351	23	M1	Attempt at ranking.
51	1	72	3																																																
55	2	86	5																																																
75	4	170	10																																																
98	6	175	11																																																
137	7	220	12																																																
152	8	260	17																																																
167	9	262	18																																																
235	13	302	19																																																
238	14	311	20																																																
242	15	320	21																																																
256	16	333	22																																																
		351	23																																																
	Total ranks: 95	A1																																																	
	$H_0: m_x = m_y$ and $H_1: m_x \neq m_y$	B1	Allow words, must include 'population' median.																																																
	Use normal approximation with attempts at mean and variance.	M1																																																	
	Mean = 132, variance = 264	A1																																																	
	$\frac{95.5 - 132}{\sqrt{264}}$	M1	Allow no or wrong continuity correction for M1 only.																																																
6	<p>- 2.246</p> <p>Critical value is - 1.96. - 2.246 < - 1.96 reject H_0.</p> <p>There is sufficient evidence of a difference in levels.</p>	A1	<p>CAO</p> <p>M1 Compare their value with - 1.96. Or area comparison 0.0123 or 0.0124 with 0.025 and FT conclusion.</p> <p>A1 Correct conclusion, in context, following correct work. Level of uncertainty in language is used.</p>																																																
		9																																																	

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Q4.

4(a)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>12</td><td>1</td><td>28</td><td>4</td></tr> <tr><td>18</td><td>2</td><td>31</td><td>6</td></tr> <tr><td>25</td><td>3</td><td>35</td><td>9</td></tr> <tr><td>29</td><td>5</td><td>36</td><td>10</td></tr> <tr><td>32</td><td>7</td><td>37</td><td>11</td></tr> <tr><td>33</td><td>8</td><td>41</td><td>13</td></tr> <tr><td>40</td><td>12</td><td>48</td><td>15</td></tr> <tr><td>46</td><td>14</td><td>49</td><td>16</td></tr> </table>	12	1	28	4	18	2	31	6	25	3	35	9	29	5	36	10	32	7	37	11	33	8	41	13	40	12	48	15	46	14	49	16		M1	Attempt at ranking.
	12	1	28	4																																
	18	2	31	6																																
	25	3	35	9																																
	29	5	36	10																																
	32	7	37	11																																
	33	8	41	13																																
40	12	48	15																																	
46	14	49	16																																	
Test statistic: 52		A1																																		
$H_0 : m_x = m_y$ and $H_1 : m_x \neq m_y$		B1	Allow in words but 'population' must be included.																																	
Critical value for (8, 8) is 49.		*B1	Allow 51 if clearly one-tail test in hypotheses.																																	
52 > 49 Accept H_0		DMI	Compare their calculated value with 49 and correct FT conclusion.																																	
Insufficient evidence of difference in medians.		A1	Correct conclusion, in context, following correct work. Level of uncertainty in language is used.																																	
		6																																		
4(b)	Not a paired sample.	B1																																		
	Underlying distribution/population not (known to be) normal Underlying distribution/population unknown	B1	B0 for 'data is not normally distributed' B0 for 'marks are not normally distributed'																																	
		2																																		

Q5.

6	Differences/rank:		M1 A1	Attempt at differences, allow 4 errors.																																																
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0.2</td><td>-0.5</td><td>-1.6</td><td>-2.9</td><td>2.5</td><td>8.5</td><td>1.2</td><td>5.2</td></tr> <tr><td>2</td><td>-5</td><td>-11</td><td>-18</td><td>17</td><td>24</td><td>9</td><td>21</td></tr> <tr><td>-0.1</td><td>0.8</td><td>7.8</td><td>1.9</td><td>-0.3</td><td>-1.8</td><td>-0.7</td><td>-1.4</td></tr> <tr><td>-1</td><td>7</td><td>23</td><td>13</td><td>-3</td><td>-12</td><td>-6</td><td>-10</td></tr> <tr><td>-0.9</td><td>2.1</td><td>2.3</td><td>-5.4</td><td>-2.0</td><td>3.4</td><td>4.7</td><td>0.4</td></tr> <tr><td>-8</td><td>15</td><td>16</td><td>-22</td><td>-14</td><td>19</td><td>20</td><td>4</td></tr> </table>	0.2	-0.5	-1.6	-2.9	2.5	8.5	1.2	5.2	2	-5	-11	-18	17	24	9	21	-0.1	0.8	7.8	1.9	-0.3	-1.8	-0.7	-1.4	-1	7	23	13	-3	-12	-6	-10	-0.9	2.1	2.3	-5.4	-2.0	3.4	4.7	0.4	-8	15	16	-22	-14	19	20	4			
	0.2	-0.5	-1.6	-2.9	2.5	8.5	1.2	5.2																																												
	2	-5	-11	-18	17	24	9	21																																												
	-0.1	0.8	7.8	1.9	-0.3	-1.8	-0.7	-1.4																																												
	-1	7	23	13	-3	-12	-6	-10																																												
	-0.9	2.1	2.3	-5.4	-2.0	3.4	4.7	0.4																																												
-8	15	16	-22	-14	19	20	4																																													
Q = 110 P = 190		A1	Either sum correct.																																																	
H_0 : population median = 18.0 and H_1 : population median \neq 18.0		B1	Must be 'population', allow m .																																																	
Mean = $\frac{1}{4}n(n+1) = \frac{1}{4} \times 24 \times 25 = 150$		B1	Normal approximation: mean.																																																	
Variance = $\frac{1}{24}n(n+1)(2n+1) = \frac{1}{24} \times 24 \times 25 \times 49 = 1225$		B1																																																		
$\frac{110.5 - 150}{\sqrt{1225}}$		M1	Attempt at test statistic, allow incorrect or missing cc, FT <i>their</i> 110.																																																	
-1.129		A1																																																		
6	10% 2-tail, critical value is 1.645 -1.129 > -1.645 or 0.1296 > 0.05, accept H_0 .	M1	Compare with -1.645, correct FT conclusion.																																																	
	Insufficient evidence to suggest that median is not 18.0/ Insufficient evidence to reject teacher's claim.	A1	Correct conclusion, in context. Level of uncertainty in language is used.																																																	
		10																																																		