UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME	:	**BACHELOR OF SCIENCE IN FOOD SCIENCE, NUTRITION AND TECHNOLOGY YEAR III**
COURSE CODE	:	**FSNT 304**
TITLE OF PAPER	:	**SENSORY EVALUATION**
TIME ALLOWED	:	**TWO (2) HOURS**
REQUIREMENTS	:	**STATISTICAL TABLES, SCIENTIFIC CALCULATOR**
INSTRUCTIONS	:	**ANSWER QUESTION ONE (1) AND ANY OTHER (2) QUESTIONS**

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Question 1

A hedonic test was conducted to determine consumers' degree of liking for five varieties (treatments) of cooked black beans using the 9-point category scale.

The beans were cooked, staggering the cooking times, so that all five samples were done ten minutes before the panel began. Twenty-eight untrained in-house consumer panelists evaluated the five samples once. Ten-gram samples of the five varieties of beans were presented simultaneously, in styrofoam sample cups with lids, to each panelist. For five samples, 120 serving orders were possible, however, with only 28 panelists this large number of serving orders was impossible to balance. Therefore, the serving order was randomized for each panelist.

After each panelist had evaluated the five samples, the descriptive categories were converted to numerical scores. The scores were tabulated and analyzed by analysis of variance. The tabulated scores for the first seven panelists are shown in the **Table 1**.

Table 1: Tabulated category scores for the hedonic test.

	Black bean varieties (Treatments)						
Panelist[1]	**A**	**B**	**C**	**D**	**E**	**Panelist total**	**Panelist mean**
1	**2**	**6**	**8**	**6**	**4**	**26**	**5.2**
2	**1**	**7**	**9**	**4**	**4**	**25**	**5.0**
3	**1**	**6**	**6**	**3**	**2**	**18**	**3.6**
4	**2**	**6**	**6**	**5**	**4**	**23**	**4.6**
5	**2**	**6**	**8**	**4**	**3**	**23**	**4.6**
6	**4**	**7**	**7**	**4**	**2**	**24**	**4.8**
7	**3**	**5**	**8**	**5**	**3**	**24**	**4.8**
Treatment total	15	43	52	31	22		
Treatment mean	2.1	6.1	7.4	4.4	3.1		
Grand total	**163**						

[1] *The responses of only 7 of the 28 panelists are given and analyzed.*

(a) Using appropriate statistical calculations, determine whether there is any significant difference in the degree of liking of the beans by the seven panelists ($\alpha = 0.5$).

[25 marks]

(b) If significant difference is found in (a), use Fisher's LSD (Least Significance Difference) to determine the varieties of beans which are different. [15 marks]

[Total marks = 40]

Question 2

(a) Define the following terms:

(i)	Threshold	[2 marks]
(ii)	Terminal threshold	[2marks]
(iii)	Recognition threshold	[2 marks]
(iv)	Difference threshold	[2 marks]
(v)	Absolute threshold	[2 marks]

[10 marks]

(b) Distinguish the differences between analytical and affective (consumer) sensory evaluation techniques. [10 marks]

(c) LIST the general design features of an ideal sensory evaluation room. [10 marks]

[Total marks = 30]

Question 3

Explain the applications of sensory evaluation in the following food processing areas:

(a) Product optimisation [5 marks]
(b) Grading/standard setting [5 marks]
(c) Development of new products [5 marks]
(d) Quality assurance [5 marks]
(e) Correlation of instrumental analysis and sensory evaluation [5 marks]
(f) Quality control [5 marks]

[Total marks = 30]

Question 4

(a) You work for MUSTARDS, a small producer of English mustard that has been in business since 1920. Two months ago, IMKE introduced English mustard on the market and it is selling like hot cakes. Your Chief Executive Officer wants you to find out different MUSTARDS' products and whether it can be positioned to take advantage of the sales drive created by IMKE. Explain how this problem may be solved. NB: Reformulation is not an option. [25 marks]

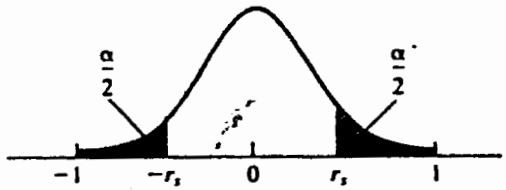
(b) Explain the factors that may be considered in the selection of panelists for sensory evaluation training. [15 marks]

[Total marks = 40]

Table 14

Critical Values of Spearman's Rank Correlation Coefficient

The entries in this table are the critical values of r_s for a two-tailed test at α. For a one-tailed test, the value of α shown at the top of the table is double the value of α being used in the hypothesis test.



n	$\alpha = 0.10$	$\alpha = 0.05$	$\alpha = 0.02$	$\alpha = 0.01$
5	0.900	—	—	—
6	0.829	0.886	0.943	—
7	0.714	0.786	0.893	—
8	0.643	0.738	0.833	0.881
9	0.600	0.683	0.783	0.833
10	0.564	0.648	0.745	0.794
11	0.523	0.623	0.736	0.818
12	0.497	0.591	0.703	0.780
13	0.475	0.566	0.673	0.745
14	0.457	0.545	0.646	0.716
15	0.441	0.525	0.623	0.689
16	0.425	0.507	0.601	0.666
17	0.412	0.490	0.582	0.645
18	0.399	0.476	0.564	0.625
19	0.388	0.462	0.549	0.608
20	0.377	0.450	0.534	0.591
21	0.368	0.438	0.521	0.576
22	0.359	0.428	0.508	0.562
23	0.351	0.418	0.496	0.549
24	0.343	0.409	0.485	0.537
25	0.336	0.400	0.475	0.526
26	0.329	0.392	0.465	0.515
27	0.323	0.385	0.456	0.505
28	0.317	0.377	0.448	0.496
29	0.311	0.370	0.440	0.487
30	0.305	0.364	0.432	0.478

Table 15

Critical values for total number of runs (V)

The entries in this table are the critical values* for a two-tailed test using $\alpha = 0.05$. For a one-tailed test, $\alpha = 0.025$ and use only one of the critical values: the smaller critical value for a left-hand critical region, the larger for a right-hand critical region.

The smaller of n_1 and n_2	The larger of n_1 and n_2: 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2								2 6	2 6	2 6	2 6	2 6	2 6	2 6	2 6	2 6
3		2 8	2 8	2 8	2 8	2 8	2 8	2 8	2 8	2 8	3 8	3 8	3 8	3 8	3 8	3 8
4	2 9	2 9	2 10	3 10	3 10	3 10	3 10	3 10	3 10	3 10	3 10	4 10	4 10	4 10	4 10	4 10
5	2 10	3 10	3 11	3 11	3 12	4 12	4 12	4 12	4 12	4 12	4 12	4 12	4 12	5 12	5 12	5 12
6		3 11	3 12	3 12	4 13	4 13	4 13	4 13	5 14	5 14	5 14	5 14	5 14	5 14	6 14	6 14
7			3 13	4 13	4 14	5 14	5 14	5 14	5 15	5 15	6 15	6 16	6 16	6 16	6 16	6 16
8				4 14	5 14	5 15	5 15	6 16	6 16	6 16	6 16	6 17	7 17	7 17	7 17	7 17
9					5 15	5 16	6 16	6 16	6 17	7 17	7 18	7 18	7 18	8 18	8 18	8 18
10						6 16	6 17	7 17	7 18	7 18	7 18	8 19	8 19	8 19	8 20	9 20
11							7 17	7 18	7 19	8 19	8 19	8 20	9 20	9 20	9 21	9 21
12								7 19	8 19	8 20	8 20	9 21	9 21	9 21	10 22	10 22
13									8 20	9 20	9 21	9 21	10 22	10 22	10 23	10 23
14										9 21	9 22	10 22	10 23	10 23	11 23	11 24
15											10 22	10 23	11 23	11 24	11 24	12 25
16												11 23	11 24	11 25	12 25	12 25
17													11 25	12 25	12 26	13 26
18														12 26	13 26	13 27
19															13 27	13 27
20																14 28

For $n_1 > 20$ or $n_2 > 20$, treat V as a normal variable with a mean and a standard deviation of

$$\mu_v = \frac{2n_1n_2}{n_1 + n_2} + 1$$

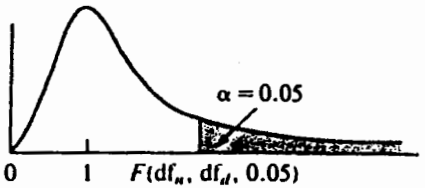
$$\sigma_v = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}}$$

* See page 532 in regard to critical values.

From C. Eisenhart and F. Swed, "Tables for testing randomness of grouping in a sequence of alternatives," *The Annals of Statistics*, vol. 14 (1943): 66–87. Reprinted by permission.

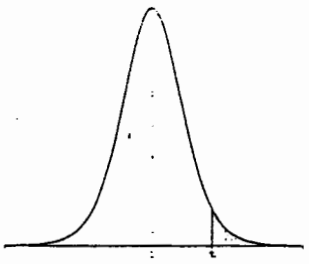
Table 4
Critical values of the F distribution ($\alpha = 0.05$)

The entries in this table are critical values of F for which the area under the curve to the right is equal to 0.05.



Degrees of Freedom for Denominator	Degrees of Freedom for Numerator																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161	200	216	225	230	234	237	239	241	242	244	246	248	249	250	251	252	253	254
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

TABLE T4
Upper-α Probability Points of Student's *t*-Distribution
(Entries Are $t_{\alpha;\nu}$)



Instructions: (1) Enter the row of the table corresponding to the number of degrees of freedom (ν) for error.
(2) Pick the value of t in that row, from the column that corresponds to the predetermined α-level.

	α						
ν	**0.25**	**0.10**	**0.05**	**0.025**	**0.01**	**0.005**	**0.0005**
1	1.000	3.078	6.314	12.706	31.821	63.657	636.619
2	0.816	1.886	2.920	4.303	6.965	9.925	31.598
3	0.765	1.638	2.353	3.182	4.541	5.841	12.941
4	0.741	1.533	2.132	2.776	3.747	4.604	8.610
5	0.727	1.476	2.015	2.571	3.365	4.032	6.859
6	0.718	1.440	1.943	2.447	3.143	3.707	5.959
7	0.711	1.415	1.895	2.365	2.998	3.499	5.405
8	0.706	1.397	1.860	2.306	2.896	3.355	5.041
9	0.703	1.383	1.833	2.262	2.821	3.250	4.781
10	0.700	1.372	1.812	2.228	2.764	3.169	4.587
11	0.697	1.363	1.796	2.201	2.718	3.106	4.437
12	0.695	1.356	1.782	2.179	2.681	3.055	4.318
13	0.694	1.350	1.771	2.160	2.650	3.012	4.221
14	0.692	1.345	1.761	2.145	2.624	2.977	4.140
15	0.691	1.341	1.753	2.131	2.602	2.947	4.073
16	0.690	1.337	1.746	2.120	2.583	2.921	4.015
17	0.689	1.333	1.740	2.110	2.567	2.898	3.965
18	0.688	1.330	1.734	2.101	2.552	2.878	3.922
19	0.688	1.328	1.729	2.093	2.539	2.861	3.883
20	0.687	1.325	1.725	2.086	2.528	2.845	3.850
21	0.686	1.323	1.721	2.080	2.518	2.831	3.819
22	0.686	1.321	1.717	2.074	2.508	2.819	3.792
23	0.685	1.319	1.714	2.069	2.500	2.807	3.767
24	0.685	1.318	1.711	2.064	2.492	2.797	3.745
25	0.684	1.316	1.708	2.060	2.485	2.787	3.725
26	0.684	1.315	1.706	2.056	2.479	2.779	3.707
27	0.684	1.314	1.703	2.052	2.473	2.771	3.690
28	0.683	1.313	1.701	2.048	2.467	2.763	3.674
29	0.683	1.311	1.699	2.045	2.462	2.756	3.659
30	0.683	1.310	1.697	2.042	2.457	2.750	3.646
∞	0.674	1.282	1.645	1.960	2.326	2.576	3.291

TABLE T7
Triangle Test for Difference: Critical Number (Minimum) of Correct Answers

Entries are the minimum number of correct responses required for significance at the stated significance level (i.e., column) for the corresponding number of respondents "n" (i.e., row). Reject the assumption of "no difference" if the number of correct responses is greater than or equal to the tabled value.

	Significance level (%)					Significance level (%)			
n	**10**	**5**	**1**	**0.1**	**n**	**10**	**5**	**1**	**0.1**
3	3	3	—	—	**26**	13	14	15	17
4	4	4	—	—	**27**	13	14	16	18
5	4	4	5	—	**28**	14	15	16	18
					29	14	15	17	19
					30	14	15	17	19
6	5	5	6	—	**31**	15	16	18	20
7	5	5	6	7	**32**	15	16	18	20
8	5	6	7	8	**33**	15	17	18	21
9	6	6	7	8	**34**	16	17	19	21
10	6	7	8	9	**35**	16	17	19	22
11	7	7	8	10	**36**	17	18	20	22
12	7	8	9	10	**42**	19	20	22	25
13	8	8	9	11	**48**	21	22	25	27
14	8	9	10	11	**54**	23	25	27	30
15	8	9	10	12	**60**	26	27	30	33
16	9	9	11	12	**66**	28	29	32	35
17	9	10	11	13	**72**	30	32	34	38
18	10	10	12	13	**78**	32	34	37	40
19	10	11	12	14	**84**	35	36	39	43
20	10	11	13	14	**90**	37	38	42	45
					96	39	41	44	48
21	11	12	13	15					
22	11	12	14	15					
23	12	12	14	16					
24	12	13	15	16					
25	12	13	15	17					

Note: For values of n not in the table compute $z = (k - (1/3)n)/\sqrt{(2/9)n}$, where k is the number of correct answers. Compare the computed value of z to the critical value of a standard normal random variable, i.e., the values in the last row of Table T4 ($z_\alpha = t_{\alpha,\infty}$).