UNIRAZAK
UNIVERSITI TUN ABDUL RAZAK

FINAL EXAMINATION
MARCH 2023

COURSE TITLE	BUSINESS STATISTICS
COURSE CODE	BMAT3213
DATE/DAY	21 JUNE 2023 / WEDNESDAY
TIME/DURATION	05:00 PM - 07:00 PM / 02 Hour(s) 00 Minute(s)

INSTRUCTIONS TO CANDIDATES :

1. Please read the instruction under each section carefully.
2. Candidates are reminded not to bring into examination hall/room any form of written materials or electronic gadget except for stationery that is permitted by the Invigilator.
3. Students who are caught breaching the Examination Rules and Regulation will be charged with an academic dishonesty and if found guilty of the offence, the maximum penalty is expulsion from the University.

(This Question Paper consists of 8 Printed Pages including front page)

DO NOT OPEN THE QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO

There are SEVEN (7) questions in this section. Answer ALL questions in the answer booklet provided. **[85 MARKS]**

1. A store carried out a sales promotion on a newly arrived T-shirt for 60 days and the number of T-shirts sold as follows:

Number of days of sales promotion	Frequency	Cumulative Frequency
$0 < n \leq 10$	210	210
$10 < n \leq 20$	134	344
$20 < n \leq 30$	78	q
$30 < n \leq 40$	p	494
$40 < n \leq 60$	46	540

a) Find the value of p and q.

(5 marks)

Years of Experience	Number of Employees
1 - 4	16
5 - 8	20
9 -12	28
13 - 16	24
17 - 20	16
21 - 24	11
25 - 28	5

b) Find the median.

(10 marks)

2. The time taken to the nearest minute to wash 8 cars are recorded as follows:

$$11 \quad 12 \quad 12 \quad 12 \quad 16 \quad 19 \quad 10 \quad 13$$

Calculate

a) mean. (4 marks)

b) standard deviation. (5 marks

c) Pearson coefficient skewness. (6 marks)

3. For the followings:

a) Let X be the number of "6" obtained when three dices) are rolled. Construct a probability distribution table for X. (6 marks)

b) The table below shows the probability distribution of a random variable X. Find the value of p. (6 marks)

$X = x$	1	2	3	4	5
$P(X = x)$	0.2	0.2	0.3	p	2p

4. The masses of guavas in a farm are normally distributed with a mean μ and a standard deviation, σ.The mass of percentages of guava that less than 400 g is 15.87% and more than 500 g is 6.68%. Determine the values of μ and σ . (10 marks)

5. A fruit stall sells tomatoes, apricots and plums. The weights of plums are normally distributed with a mean of 80 grams and standard deviation 4 grams. Five plums are chosen at random, find the probability exactly three of them weigh more than 82 grams. (10 marks)

6. A random sample of size 40 is taken from the binomial $B(50,0.4)$.Find the probability that the sample mean is

a) more than 19. (4 marks)

b) lies between 18.5 and 20. (5 marks)

7. A certain type of tennis ball is known to have a bounce height which is normally is normally distributed with a standard deviation of 2 cm. A random sample of 60 tennis ball is tested and the mean bounce height of the sample is 140 cm. Find

a) a symmetrical 95% confidence interval for mean bounce height. (7 marks)

b) a symmetrical 99% confidence interval for mean bounce height. (7 marks)

*** **END OF QUESTION PAPER** ***

List of Formulas

1. Sample Mean: $\bar{X} = \frac{\sum x}{n}$

2. Population Mean: $\mu = \frac{\sum X}{N}$

3. *Grouped Data*

$Mean: \bar{X} = \frac{\sum fx}{\sum f}$

$Median \ = L_m + \left[\frac{\frac{n}{2} - F}{f_m}\right] c$

$Mode = L + \left[\frac{f_0 - f_1}{(f_0 - f_1) + (f_0 - f_2)}\right] \times c$

4. *Population (Ungrouped Data)*

$Mean : \mu = \frac{\sum x}{N}$

$Variance: \sigma^2 = \frac{\sum x^2}{N} - (\bar{X})^2$ @ $\frac{1}{N}\sum(X - \mu)^2$

$Standard\ deviation: \sigma = \sqrt{\frac{\sum x^2}{N} - (\bar{X})^2}$ @ $\sqrt{\frac{1}{N}\sum(X - \mu)^2}$

5. *Sample (Ungrouped Data)*

$Variance: s^2 = \frac{1}{n-1}\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]$

$Standard\ deviation : s = \sqrt{\frac{1}{n-1}\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]}$

6. *Population (Grouped Data)*

$Mean : \mu = \frac{\sum fx}{\sum f(N)}$

$Variance: \sigma^2 = \frac{\sum fx^2}{\sum f(N)} - (\bar{X})^2$

$Standard\ deviation: \sigma = \sqrt{\frac{\sum fx^2}{\sum f(N)} - (\bar{X})^2}$.

7. *Sample (Grouped Data)*

$Variance: s^2 = \frac{1}{n-1}\left[\sum fx^2 - \frac{(\sum fx)^2}{n}\right]$

$Standard\ deviation : s = \sqrt{\frac{1}{n-1}\left[\sum fx^2 - \frac{(\sum fx)^2}{n}\right]}$

8.$Pearson's\ coefficient\ of\ skewness$

$$Skewness = \frac{Mean - Mode}{Standard\ deviation} \ @ \ \frac{3(Mean - Median)}{Standard\ deviation}$$

9.$Binomial$

$P(X = r) = C_r\, p^r\, q^{n-r}$

$Mean = np$

$Variance = npq$

$Standard\ deviation = \sqrt{npq}$

10. $Poisson\ \ Distribution$

$P(X = r) = e^{-\mu}\, \frac{\mu^r}{r!}$

11.$Normal\ Distribution$

$z = \frac{X - \mu}{\sigma}$

12.

$E(\bar{X}) = \mu$

$Var\,(\bar{X}) = \frac{\sigma^2}{n}$

13.$Confidence\ Interval\ for\ Population\ Mean$

$(with\ known\ variance\ \&\ sample\ size\ > 30)$

$P(\bar{X} - E \le \mu \le \bar{X} + E)$,

$E = \pm z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}, E = marginal\ of\ error$

$Confidence\ interval\ will$

$(\bar{X} - E, \bar{X} + E)$

14.$Confidence\ Interval\ for\ Population\ Mean$

$(with\ unknown\ variance\ \&\ sample\ size\ < 30)$

$(\bar{X} - E \le \bar{X} \le \bar{X} + E)$

$E = \pm t_{\frac{\alpha}{2}} \frac{\hat{\sigma}}{\sqrt{n}}$

$Confidence\ interval\ will$

$(\bar{X} - t_{\frac{\alpha}{2}} \frac{\hat{\sigma}}{\sqrt{n}}, \bar{X} + t_{\frac{\alpha}{2}} \frac{\hat{\sigma}}{\sqrt{n}})$

15.

Significance test

Population mean (Normal) with known variance

$$Test\ Statistics\ z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

Population mean (Normal) with unknown variance

$$Test\ Statistics\ z = \frac{x - \mu}{\frac{s}{\sqrt{n}}}$$

16. *Anova*

$$Test\ Statistics: \frac{{s_1}^2}{{s_2}^2}$$

$$F = \frac{estimated\ population\ variance\ between\ the\ sample}{estimated\ population\ variance\ within\ the\ sample}$$

17.

$$r = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

Test statistics: $t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$

$$b = \frac{n\sum XY - (\sum X)(\sum Y)}{n(\sum X^2) - (\sum X)^2} \qquad a = \frac{\sum Y}{n} - b\frac{\sum X}{n}$$

$$s_{y.x} = \sqrt{\frac{\sum(Y - Y')^2}{n-2}}$$

$$Test\ statistics, t = \frac{b}{SE(b)}$$

18.

Confidence Interval of an Estimate

$$Y' \pm t_{\frac{\alpha}{2}} s_{y.x} \sqrt{\frac{1}{n} + \frac{(X - \bar{X})^2}{\sum X^2 - \left[\frac{(\sum X)^2}{n}\right]}}$$

Prediction Interval of an Estimate

$$Y' \pm t_{\frac{\alpha}{2}} s_{y.x} \sqrt{1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{\sum X^2 - \left[\frac{(\sum X)^2}{n}\right]}}$$

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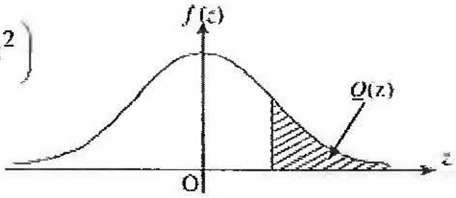
THE UPPER TAIL PROBABILITY Q(z) FOR THE NORMAL DISTRIBUTION N(0,1)
***KEBARANGKALIAN HUJUNG ATAS Q(z) BAGI TABURAN NORMAL* N(0, 1)**

z	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
															Minus / Tolak				
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641	4	8	12	16	20	24	28	32	36
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247	4	8	12	16	20	24	28	32	36
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859	4	8	12	15	19	23	27	31	35
0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483	4	7	11	15	19	22	26	30	34
0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121	4	7	11	15	18	22	25	29	32
0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776	3	7	10	14	17	20	24	27	31
0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451	3	7	10	13	16	19	23	26	29
0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148	3	6	9	12	15	18	21	24	27
0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867	3	5	8	11	14	16	19	22	25
0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611	3	5	8	10	13	15	18	20	23
1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379	2	5	7	9	12	14	16	19	21
1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170	2	4	6	8	10	12	14	16	18
1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985	2	4	6	7	9	11	13	15	17
1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823	2	3	5	6	8	10	11	13	14
1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681	1	3	4	6	7	8	10	11	13
1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559	1	2	4	5	6	7	8	10	11
1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455	1	2	3	4	5	6	7	8	9
1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367	1	2	3	4	4	5	6	7	8
1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294	1	1	2	3	4	4	5	6	6
1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233	1	1	2	2	3	4	4	5	5
2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183	0	1	1	2	2	3	3	4	4
2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143	0	1	1	2	2	2	3	3	4
2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110	0	1	1	1	2	2	2	3	3
2.3	0.0107	0.0104	0.0102								0	1	1	1	1	2	2	2	2
				0.00990	0.00964	0.00939	0.00914				3	5	8	10	13	15	18	20	23
								0.00889	0.00866	0.00842	2	5	7	9	12	14	16	16	21
2.4	0.00820	0.00798	0.00776	0.00755	0.00734						2	4	6	8	11	13	15	17	19
						0.00714	0.00695	0.00676	0.00657	0.00639	2	4	6	7	9	11	13	15	17
2.5	0.00621	0.00604	0.00587	0.00570	0.00554	0.00539	0.00523	0.00508	0.00494	0.00480	2	3	5	6	8	9	11	12	14
2.6	0.00466	0.00453	0.00440	0.00427	0.00415	0.00402	0.00391	0.00379	0.00368	0.00357	1	2	3	5	6	7	9	9	10
2.7	0.00347	0.00336	0.00326	0.00317	0.00307	0.00298	0.00289	0.00280	0.00272	0.00264	1	2	3	4	5	6	7	8	9
2.8	0.00256	0.00248	0.00240	0.00233	0.00226	0.00219	0.00212	0.00205	0.00199	0.00193	1	1	2	3	4	4	5	6	6
2.9	0.00187	0.00181	0.00175	0.00169	0.00164	0.00159	0.00154	0.00149	0.00144	0.00139	0	1	1	2	2	3	3	4	4
3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00104	0.00100	0	1	1	2	2	2	3	3	4

$$f(z) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2} z^2\right)$$

$$Q(z) = \int_k^{\infty} f(z)\, dz$$



Example / *Contoh*:

If $X \sim N(0, 1)$, then $P(X > k) = Q(k)$
Jika $X \sim N(0, 1)$, *maka* $P(X > k) = Q(k)$

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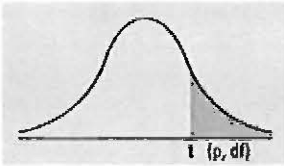
Numbers in each row of the table are values on a *t*-distribution with
(*df*) degrees of freedom for selected right-tail (greater-than) probabilities (*p*).



df/p	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052	63.65674	636.6192
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456	9.92484	31.5991
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070	5.84091	12.9240
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695	4.60409	8.6103
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493	4.03214	6.8688
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267	3.70743	5.9588
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795	3.49948	5.4079
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646	3.35539	5.0413
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144	3.24984	4.7809
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377	3.16927	4.5869
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808	3.10581	4.4370
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100	3.05454	43178
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031	3.01228	4.2208
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449	2.97684	4.1405
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248	2.94671	4.0728
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349	2.92078	4.0150
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693	2.89823	3.9651
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238	2.87844	3.9216
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948	2.86093	3.8834
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798	2.84534	3.8495
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765	2.83136	3.8193
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832	2.81876	3.7921
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987	2.80734	3.7676
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216	2.79694	3.7454
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511	2.78744	3.7251
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863	2.77871	3.7066
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266	2.77068	3.6896
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714	2.76326	3.6739
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202	2.75639	3.6594
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726	2.75000	3.6460
z	0.253347	0.674490	1.281552	1.644854	1.95996	2.32635	2.57583	3.2905
CI	———	———	80%	90%	95%	98%	99%	99.9%