Final Exam Second Semester of 2018/2019

Statistics for Economics and Business

Date : Tuesday, May 28, 2019
Time : 180 minutes
Lecturers : Team

You may use calculator
The use of celluler phone for calculator is strictly prohibited

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Note: **This set of problems is divided into four groups with similar contribution to the total mark. Figures in brackets with bold and italic are points for the questions.**

Problem I.

An owner of a café wants to know the number of baristas to be allocated on Monday mornings. For that purpose he conducts an observation on the number of customers between 07.30 – 09.00 AM. The number of customers are counted for the duration of every 5 minutes at random for several Mondays. The result are presented at table below.

Number of customers Coming Every 5 Minutes	Frequency
0	3
1	21
2	30
3	21
4	18
5	15
6	6
7	3
8	3
Total	**120**

Qustions

1. Construct a probability distribution on the number of customers come within an interval of five minutes based on the table above. ***[5]***
2. Calculate the expected value of the number of customers come within an interval of five minutes. ***[4]***
3. The expected value is then used for a theoretical Poisson distribution for the number of customers come within an interval of five minutes. Find the probability that at most four customer come within that interval. ***[7]***
4. What is the probability that more than one customer comes during two consecutive five minute interval. ***[4]***

5. Compare the empirical distribution (on Question 1) and theoretical distribution (on Question3) for up to four customers coming to the café. Does theoretical Poisson distribution is a good approximation for this case? Explain why. ***[5]***

Problem II.

Ali, a hydroponic businessman, has outlets in all corners of Indonesia. For spinach, Ali sells hydroponic at a price of Rp. 12,500 per bundle. However, it turns out that it is difficult to get the weight of per-bundle spinach at exactly 100 gram and Ali gets the average weight of per-bundle spinach weighing of 101.5 gram with a standard deviation of 3 gram. Weight per bundle of spinach follows normal distribution.

1. Explain the characteristics of a normal distribution. ***[2]***
2. Which parameter(s) should be used to describe a normal distribution completely? ***[2]***
3. Find the probability that a bundle weight of spinach will be more than 103 gram. ***[5]***
4. Find the probability that a bundle weight of spinach is between 99 gram and 102 gram. ***[6]***
5. What is the limit of weight of a bundle spinach which is 95% of the heaviest? ***[5]***
6. What is the limit of weight of a bundle spinach which is 75% of the lightest? ***[5]***

Problem III.

A regent on the island of Sumatra visited several villages in his area. He found out that two villages have not been electrified. And the next day, in collaboration with electricity company (PLN), they agreed to build an electricity network in the two villages. The regent immediately conducted a small research by taking each of the 20 households as samples. Based on the data obtained, the two villages have different expenditure restrictions. This certainly has an impact on the application of PLN tariffs that will be imposed in both villages, whether it can be made the same or not. The regent asked the help of FEB UI 2018 students to conduct several things as asked below.

Another important information that can be known by FEB UI students is that the regent has not known the population standard deviation in each village. But he also believes that public is normally distributed.

Help the regent to conduct several activities as follows:

1. Calculation on sample standard deviations for each village! ***[5]***
2. With that data sample, what is the theoretical probability distribution should be used in inferential statistics activities? ***[3]***
3. Determine confidence intervals in Village A with 95% and 99% confidence levels. ***[10]***
4. What will happen to the width of the interval if we add the sample size at similar confidence level? ***[2]***
5. Suppose it is known that the population standard deviation of Village A be Rp0.68 Million. For a confidence interval with the margin of error being targeted as Rp 0.23 Million, what is the confidence level to be admitted? ***[5]***

Table on Monthly Expenditure Village A and Villaga B (in Million Rupiahs)

Observation	Expenditure Village A	Expenditure Village B
1	2.76	3.06
2	0.99	4.88
3	2.96	4.25
4	0.98	3.44
5	3.00	4.00
6	2.10	3.69
7	2.54	3.57
8	2.67	3.74
9	1.40	2.87
10	2.72	3.25
11	3.09	4.62
12	2.66	3.18
13	3.07	3.97
14	2.22	2.93
15	1.63	4.86
16	2.60	3.72
17	1.54	2.93
18	2.67	2.99
19	1.41	3.86
20	1.68	4.90
Total	**44.63**	**74.71**
Average	**2.23**	**3.74**

Problem IV.

A president of a reputable university feels unpleasant with the capability of her students on learning using information and communication technology (ICT). Some senior lecturers claim that the proportion of students who have sufficient capability on that learning method is less than 0.40. Due to the issue, the university conducts a study by in-depth interviewing to 400 students at random on their capability to learn using ICT. The result is that 142 students are considered as capable in that learning method.

Questions:

1. Conduct a hypothesis test on the statement of senior lecturers with 0.05 significance level. What is the result? Is their statement being supported by data? ***[7]***
2. Conduct a hypothesis test on the statement with 0.01 significance level. What is the result? Is their statement being supported by data? ***[6]***
3. Calculate the p-value for Question 1. Will it be similar to p-value for Question 2? Explain why. ***[5]***
4. Suppose the actual proportion of students who have sufficient capability with ICT learning process is 0.36, what is the Type 2 error of the test at Question 1? ***[7]***

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Selected Formulas

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1} \; ; \; s^2 = \frac{\sum (m_i - \bar{x})^2 f_i}{n-1} \; ; \; \sigma^2 = \frac{\sum (x_i - \mu)^2}{N} \; ; \; \sigma^2 = \frac{\sum (m_i - \mu)^2 f_i}{N}$$

$$P(X = x) = \frac{e^{-\mu}\mu^x}{x!} \quad ; \quad Var(X) = \mu$$

$$P(x \geq a) = e^{-\lambda a}$$

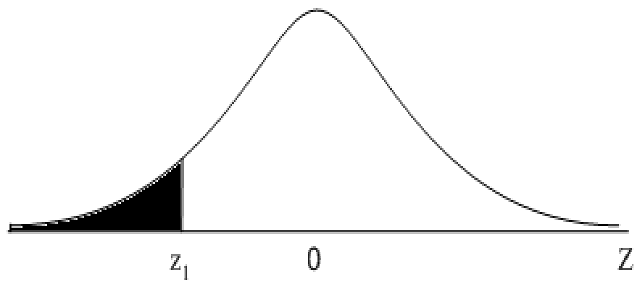
$$\sigma_{\bar{X}} = \frac{\sigma_X}{\sqrt{n}} \quad \text{or} \quad \sigma_{\bar{X}} = \frac{\sigma_X}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}} \quad \text{and} \quad \hat{\sigma}_{\bar{X}} = \frac{s_X}{\sqrt{n}} \quad \text{or} \quad \hat{\sigma}_{\bar{X}} = \frac{\sigma_X}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$$

$$\sigma_p = \sqrt{\frac{\pi(1-\pi)}{n}} \quad \text{or} \quad \sigma_p = \sqrt{\frac{\pi(1-\pi)}{n}} \times \sqrt{\frac{N-n}{N-1}}$$

$$\text{and} \quad \sigma_p = \sqrt{\frac{p(1-p)}{n}} \quad \text{or} \quad \sigma_p = \sqrt{\frac{p(1-p)}{n}} \times \sqrt{\frac{N-n}{N-1}}$$

Normal Standard Z Distribution:

Content of the table shows area under the curve or probability of Z up to z_1 [$P(Z < Z_1)$]

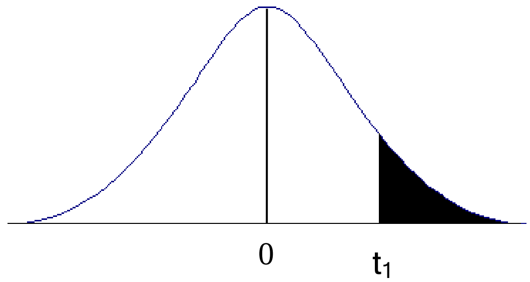


Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
–3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
–2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
–2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
–2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
–2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
–2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
–2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
–2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
–2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
–2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
–2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
–1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
–1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
–1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
–1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
–1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
–1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
–1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
–1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
–1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
–1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
–0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
–0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
–0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
–0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
–0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
–0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
–0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
–0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
–0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
–0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993

Student *t* Distribution:

Content in the table shows that with the degrees of freedom on the left margin, the probability of the t-value will be greater than content in the table is α as showed at the top of the margin [$P(t > t_1) = \alpha$].
For df = 12, P (t > 1.7823) = 0.05; and
For df = 12, P (t < – 1.7823) = 0.05



df \ α	0.1	0.05	0.025	0.01	0.005
1	3.0777	6.3137	12.7062	31.8210	63.6559
2	1.8856	2.9200	4.3027	6.9645	9.9250
3	1.6377	2.3534	3.1824	4.5407	5.8408
4	1.5332	2.1318	2.7765	3.7469	4.6041
5	1.4759	2.0150	2.5706	3.3649	4.0321
6	1.4398	1.9432	2.4469	3.1427	3.7074
7	1.4149	1.8946	2.3646	2.9979	3.4995
8	1.3968	1.8595	2.3060	2.8965	3.3554
9	1.3830	1.8331	2.2622	2.8214	3.2498
10	1.3722	1.8125	2.2281	2.7638	3.1693
11	1.3634	1.7959	2.2010	2.7181	3.1058
12	1.3562	1.7823	2.1788	2.6810	3.0545
13	1.3502	1.7709	2.1604	2.6503	3.0123
14	1.3450	1.7613	2.1448	2.6245	2.9768
15	1.3406	1.7531	2.1315	2.6025	2.9467
16	1.3368	1.7459	2.1199	2.5835	2.9208
17	1.3334	1.7396	2.1098	2.5669	2.8982
18	1.3304	1.7341	2.1009	2.5524	2.8784
19	1.3277	1.7291	2.0930	2.5395	2.8609
20	1.3253	1.7247	2.0860	2.5280	2.8453
21	1.3232	1.7207	2.0796	2.5176	2.8314
22	1.3212	1.7171	2.0739	2.5083	2.8188
23	1.3195	1.7139	2.0687	2.4999	2.8073
24	1.3178	1.7109	2.0639	2.4922	2.7970
25	1.3163	1.7081	2.0595	2.4851	2.7874
26	1.3150	1.7056	2.0555	2.4786	2.7787
27	1.3137	1.7033	2.0518	2.4727	2.7707
28	1.3125	1.7011	2.0484	2.4671	2.7633
29	1.3114	1.6991	2.0452	2.4620	2.7564
30	1.3104	1.6973	2.0423	2.4573	2.7500
40	1.3031	1.6839	2.0211	2.4233	2.7045
50	1.2987	1.6759	2.0086	2.4033	2.6778
60	1.2958	1.6706	2.0003	2.3901	2.6603
80	1.2922	1.6641	1.9901	2.3739	2.6387
100	1.2901	1.6602	1.9840	2.3642	2.6259
120	1.2886	1.6576	1.9799	2.3578	2.6174