Public Policy 529
Midterm Exam Winter 2017

Student ID number (8-digits): ________________________

1. Suppose that the number of hours people sleep has a normal distribution with a mean of 7 and a standard deviation of 1.2.

   (a) What percentage of people sleep less than 7.5 hours?

   (b) What percentage of people sleep less than 5.5 hours?

   (c) What percentage of people sleep 6 to 8 hours?

(d) If you were to take repeated samples of size n=200 from this population, calculating the sample mean each time, in what range would 95% of the sample means fall?

2. In a recent survey of people who voted for Donald Trump (n=712), 51% of respondents say that the Bowling Green Massacre shows why Trump's immigration policy is needed.

   (a) Calculate a 99% confidence interval for this estimate.

   (b) Interpret this confidence interval.

3. The table below is the joint probability distribution for two variables in the American population. One variable indicates whether a person was born in this country (yes, no). The other variable shows opinions on how important it is to speak English (very, fairly, not very, not at all).

Importance of Speaking English	Born in this Country? Yes	No	Total
Very	.62	.11	.73
Fairly	.18	.03	.21
Not Very	.04	.00	.04
Not at All	.02	.00	.02
Total	.86	.14	1.00

(a) What are the measurement levels of these two variables?

(b) What is P(Yes or Fairly)?

(c) What is P(No and Very)?

(d) What is P(Very | Yes)? What is P(Very | No)?

(e) Are these two variables independent of each other? How do you know?

4. In random sample survey, the mean amount of time spent commuting to work or school was 25 minutes (s=15; n=900).

   (a) Construct a 95% confidence interval for this mean.

   (b) Interpret this confidence interval.

5. Answer true or false to the following questions.

   (a) According to the Central Limit Theorem, the sampling distribution of the sample mean is always normal even if the population distribution is highly skewed.

   (b) A survey researcher calls only during daytime hours, producing a sample with a high proportion of retirees. The responses to the survey questions thus contain response bias.

   (c) The larger the standard deviation of a variable in the population, the lower the level of precision when estimating the population mean with a sample mean.

   (d) If a measurement strategy has validity, but low reliability, the consequence is bias.

6. When people buy a used car that turns out to have lots of mechanical problems, they call it a "lemon." Suppose that 20% of used cars on the market are lemons. Before buying, you can take a car to a mechanic to check it out. If the car is a lemon, there is an 80% chance that the mechanic will identify it as a lemon. On the other hand, the mechanic will wrongly identify 15% of good cars as lemons.

   (a) Make a joint probability distribution table or probability tree to represent this situation.

   (b) What is the probability that a car taken to the mechanic will be called a lemon?

   (c) What is the probability that a car is actually a lemon if the mechanic says it is okay?

7. The table below shows answers to a survey question that asks how often the respondent trusts other people.

How Often Trust Others?	Freq.	Percent	Cum.
1. Always Trust	37	2.99	2.99
2. Usually Trust	427	34.49	37.48
3. Usually Do Not Trust	628	50.73	88.21
4. Never Trust	146	11.79	100.00
Total	1,238	100.00	

(a) What is the measurement level of this variable?

(b) Calculate all appropriate measures of central tendency.

(c) What proportion of people say that they always or usually trust others?

(d) Find an 80% confidence interval for the proportion that you found in part (c).

List of Formulas

Descriptive and Distributional Statistics

$$\bar{y} = \frac{\sum y_i}{n} \qquad s^2 = \frac{\sum (y_i - \bar{y})^2}{n-1} \qquad Z = \frac{y - \mu_y}{\sigma}$$

$$IQR = Q_3 - Q_1$$

$$SS = \sum (y_i - \bar{y})^2 \qquad s = \sqrt{\frac{\sum (y_i - \bar{y})^2}{n-1}} \qquad \sigma_{\bar{y}} = \frac{\sigma}{\sqrt{n}}$$

Probability

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)} \qquad P(A \text{ and } B) = P(A) \times P(B|A)$$

$$P(\sim A) = 1 - P(A)$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \qquad P(A \text{ and } B) = P(A) \times P(B)$$

Confidence Intervals and Significance Tests

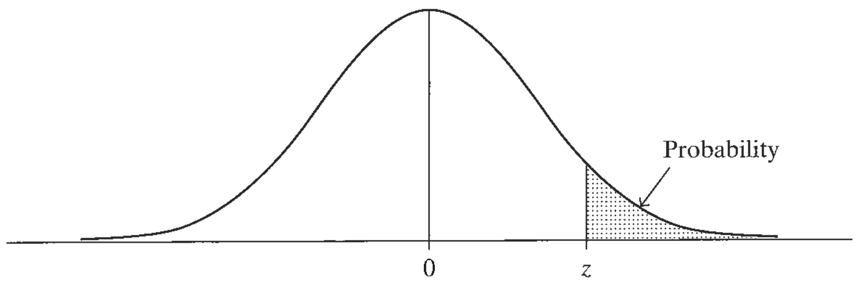
$$Z \text{ or } t = \frac{\bar{y} - \mu_0}{\hat{\sigma}_{\bar{y}}} \qquad \hat{\sigma}_{\hat{\pi}} = \sqrt{\frac{\hat{\pi}(1-\hat{\pi})}{n}}$$

$$Z = \frac{\hat{\pi} - \pi_0}{\hat{\sigma}_{\pi_0}} \qquad \text{c.i.} = \bar{y} \pm t \cdot \hat{\sigma}_{\bar{y}}$$

$$\hat{\sigma}_{\bar{y}} = \frac{s}{\sqrt{n}} \qquad \text{c.i.} = \bar{y} \pm Z \cdot \hat{\sigma}_{\bar{y}}$$

$$\hat{\sigma}_{\pi_0} = \sqrt{\frac{\pi_0(1-\pi_0)}{n}} \qquad \text{c.i.} = \hat{\pi} \pm Z \cdot \hat{\sigma}_{\hat{\pi}}$$

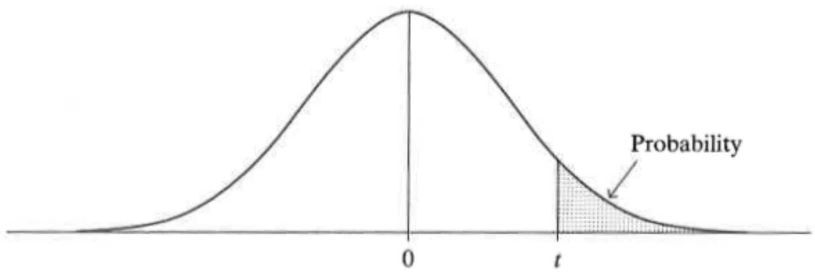
TABLE A: Normal curve tail probabilities. Standard normal probability in right-hand tail (for negative values of z, probabilities are found by symmetry)



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
	Second Decimal Place of z									
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0722	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0352	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
2.9	.0019	.0018	.0017	.0017	.0016	.0016	.0015	.0015	.0014	.0014
3.0	.00135									
3.5	.000233									
4.0	.0000317									
4.5	.00000340									
5.0	.000000287									

Source: R. E. Walpole, *Introduction to Statistics* (New York: Macmillan, 1968).

TABLE B: *t* Distribution Critical Values



	Confidence Level					
	80%	90%	95%	98%	99%	99.8%
	Right-Tail Probability					
df	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	$t_{.001}$
1	3.078	6.314	12.706	31.821	63.656	318.289
2	1.886	2.920	4.303	6.965	9.925	22.328
3	1.638	2.353	3.182	4.541	5.841	10.214
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.894
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144
11	1.363	1.796	2.201	2.718	3.106	4.025
12	1.356	1.782	2.179	2.681	3.055	3.930
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733
16	1.337	1.746	2.120	2.583	2.921	3.686
17	1.333	1.740	2.110	2.567	2.898	3.646
18	1.330	1.734	2.101	2.552	2.878	3.611
19	1.328	1.729	2.093	2.539	2.861	3.579
20	1.325	1.725	2.086	2.528	2.845	3.552
21	1.323	1.721	2.080	2.518	2.831	3.527
22	1.321	1.717	2.074	2.508	2.819	3.505
23	1.319	1.714	2.069	2.500	2.807	3.485
24	1.318	1.711	2.064	2.492	2.797	3.467
25	1.316	1.708	2.060	2.485	2.787	3.450
26	1.315	1.706	2.056	2.479	2.779	3.435
27	1.314	1.703	2.052	2.473	2.771	3.421
28	1.313	1.701	2.048	2.467	2.763	3.408
29	1.311	1.699	2.045	2.462	2.756	3.396
30	1.310	1.697	2.042	2.457	2.750	3.385
40	1.303	1.684	2.021	2.423	2.704	3.307
50	1.299	1.676	2.009	2.403	2.678	3.261
60	1.296	1.671	2.000	2.390	2.660	3.232
80	1.292	1.664	1.990	2.374	2.639	3.195
100	1.290	1.660	1.984	2.364	2.626	3.174
∞	1.282	1.645	1.960	2.326	2.576	3.091

Source: "Table of Percentage Points of the *t*-Distribution." Computed by Maxine Merrington, Biometrika, 32 (1941): 300.