Final for Statistics 301
Elementary Statistical Methods - Spring 2001
Material Covered: Chapters 1–11 of Workbook and text
For: 30th April

This is a 2 hour final, worth 25% and marked out of 25 points. The total possible points awarded for each question is given in square brackets at the beginning of each question. Anything that can fit on two sides of an $8\frac{1}{2}$ by 11 inch piece of paper may be used as a reference during this final. A calculator and appropriate statistical tables may also be used. No other aids are permitted.

Name (please print): _____ . **ID Number:** _____.

last   first

---

1. [1 point] The winning times for twenty 100 meter dashes in Porter county in 1939–40 are given below.

7.9	7.9	7.9	8.1	8.6	8.7	8.9	9.2	9.3	9.5
10.2	10.3	10.4	10.8	11.5	12	12	12.3	12.6	13.6

The winning times for twenty 100 meter dashes in Porter county in 1999–2000 are given below.

7.3	7.3	7.4	7.9	7.9	8.1	8.3	9.1	9.1	9.3
9.4	9.4	10.3	10.3	10.5	11.2	11.3	11.3	11.6	11.6

Draw a back–to–back stem and leaf plot. Have the times improved from 1939–40 to 1999–2000?

2. Consider the following long distance per minute charges for 20 regions.

| 4.3 | 5 | 5.9 | 6.8 | 7.6 | 7.7 | 7.9 | 8.2 | 8.3 | 9.5 |
| 10.2 | 10.3 | 10.4 | 10.8 | 11.5 | 12 | 12 | 12.3 | 12.6 | 13.6 |

(a) [1 point] The coefficient of variation is
(circle closest one) **13 / 17 / 23 / 28 / 31**.

(b) [1 point] According to Chebyshev's rule, at least what proportion of the charges should fall within 3.2 standard deviations of the average?
Circle closest one. **0.77 / 0.82 / 0.85 / 0.90 / 0.93**.

(c) [1 point] If the data above followed a normal distribution, approximately what proportion of the charges should fall within 3.2 standard deviations of the average?
Circle closest one. **0.975 / 0.979 / 0.983 / 0.989 / 0.998**.

---

3. In how many ways can five married couples sitting in a row of ten seats be arranged if:

(a) [1 point] Each married couple is seated together?
Circle closest one. **120 / 240 / 720 / 3,840 / 3,628,800**.

(b) [1 point] The members of each gender are seated together?
Circle closest one. **4,800 / 6,200 / 8,600 / 24,000 / 28,800**.

---

4. There is a 43% chance of making a basket on a free throw and each throw is independent of each other throw.

(a) [1 point] The chance the first basket is made on the seventh throw is
(circle closest one) **0.005 / 0.015 / 0.018 / 0.019 / 0.023**.

(b) [1 point] The expected number of throws to make the first basket is
(circle closest one) **2.33 / 4.65 / 6.11 / 8.39 / 10.42**.

(c) [1 point] The chance the *second* basket is made on the third throw is
(circle closest one) **0.053 / 0.133 / 0.181 / 0.211 / 0.267**.

5. [3 points] A 10 kilogram weight, held by the National Institute of Standards and Technology in Washington, DC, is weighed many times by an unbiased measuring instrument.

(a) True / False. If weighed 500 times, a histogram of these 500 measurements must almost certainly be normal shaped.

(b) True / False. The average of 500 measurements is almost certainly a better estimate, than the average of 200 measurements, of the actual weight of the 10 kilogram weight .

(c) True / False. The average of 500 measurements almost certainly has a larger standard error than the standard error associated with the average of 200 measurements.

(d) True / False. The chance the average of 500 measurements is larger than 10.1 kilograms is larger than the chance the average of 200 measurements is larger than 10.1 kilograms.

(e) True / False. The chance the average of 500 measurements is between 9.9 and 10.1 kilograms is larger than the chance the average of 200 measurements is between 9.9 and 10.1 kilograms.

(f) True / False. *If* the measuring instrument is biased (it measures the 10 kilogram weight heavy by 0.1 kilogram), then the average of 500 measurements is almost certainly a better estimate of the actual weight of the 10 kilogram weight than the average of 200 measurements.

---

6. Information services (IS) at Purdue University North Central is interested in figuring out how the students use the computers on campus.

(a) [1 point] How many observations are necessary to be 99% confident that the point estimate of the proportion $\hat{p}$ of students who use their PU/NC email accounts is "off" from the true proportion p by at most 5%?
Circle closest one. **346 / 444 / 541 / 603 / 665**.

(b) [1 point] How many observations are necessary to be 95% confident that the point estimate of the average number $\bar{X}$ of students who use the Open Lab is "off" from the true average μ by at most 3 students, when $\sigma = 10$?
Circle closest one. **39 / 43 / 50 / 55 / 60**.

(Hint: Both problems are related to determining the sample size of a confidence interval.)

7. A study is conducted to determine the effect of internet learning on the final exam scores of 6 students. Student 1 is taught over the internet for three months and given a final exam on the material covered. This same student is then taught in the classroom for the next three month and given a final exam on the new material covered. The other students are treated in the same way.

student	1	2	3	4	5	6
classroom final exam score	68	87	88	72	52	70
internet final exam score	57	75	72	66	43	61

Test if the average classroom final exam score is greater than the average internet final exam score at 5%.

(a) [1 point] p–value = _____.

(b) [1 point] What is most likely confounding the results here? (Please give a short one sentence answer.)

---

8. An elastic band is stretched. The width of this elastic band is measured for various lengths of stretch.

band width, x	-2.1	-1.7	-1.1	-1.5	-2.7
stretch length, y	40	37	35	36	42

(a) [1 point] The least–squares line is (circle closest one)

    (i) $y_p = 29.44 - 4.70x$ **(ii)** $y_p = 29.44 - 5.70x$ **(iii)** $y_p = 29.44 - 6.70x$
        (iv) $y_p = 29.44 - 7.70x$ **(v)** $y_p = 29.44 - 8.70x$

(b) [1 point] S_e = (circle closest one) **0.30 / 0.40 / 0.50 / 0.60 / 0.70**.

(c) [1 point] SS_x = (circle closest one) **1.388 / 1.288 / 1.488 / 1.588 / 1.688**.

9. The observed data from a random sample of 223 people in an investigation of the effect of ethnic group on the type of movie preferred is given in the table below.

	ethnic group →	A	B	C	row totals
type	drama	10	25	35	70
of	comedy	20	21	11	52
movie	action	30	28	43	101
	column totals	60	74	89	223

Test if ethnic group is dependent on the type of movie preferred at $\alpha = 0.05$.

(a) [1 point] observed test statistic =
(circle closest one) **9.5 / 11.7 / 13.2 / 14.7 / 15.4**.

(b) [1 point] critical value = (circle closest one) **9.5 / 11.7 / 13.2 / 14.7 / 15.4**.

(c) [1 point] We find that ethnic group (circle one)
is independent of / depends on on the type of movie preferred.

---

10. Where are the rats in New York city? The rat count per square meter is recorded and shown in the following table.

sewers	parks	city hall
3	1	5
5	3	8
7	2	9
4		8
		10

Test the claim that the average rat count per square meter in at least two of the three city areas is different at 1%.

(a) [1 point] p–value = (circle closest one) **0.002 / 0.005 / 0.007 / 0.010 / 0.013**.

(b) [1 point] We (circle one) **accept / reject** the null hypothesis that the average rat count per square meter in all of the three city areas is the same.

(c) [1 point] The p–value is small because, relatively speaking, (circle one)

(i) both MS_{BET} and MS_W are small.
(ii) MS_{BET} is small and MS_W is large.
(iii) MS_{BET} is large and MS_W is small.
(iv) both MS_{BET} and MS_W are large.
(v) the F statistic is small.

(1) yes, times have improved

					stem						
100		9	9	9	7	3	3	4	9	9	100
dash	9	7	6	1	8	1	3				dash
times,		5	3	2	9	1	1	3	4	4	times,
1939	8	4	3	2	10	3	3	5			1999
1940				5	11	2	3	3	6	6	2000
	6	3	0	0	12						stem: 1s
				6	13						leaves: 0.1s

(2) (a) **28**   (b) **0.90**   (c) **0.998**

(3) (a) **3, 840**;   (b) **28, 800**

(4) (a) **0.015**   (b) **2.33**   (c) **0.211**.

(5) (a) **False**   (b) **True**   (c) **False**
(d) **False**   (e) **True**   (f) **False**

(6) (a) **665**   (b) **43**

(7) (a) **0.000316**
(b) **The different material covered for internet and classroom instruction is most likely confounding the results.**

(8) (a) **(i)** $y_p = 29.44 - 4.70x$ (b) **0.60**,   (c) **1.488**

(9) (a) **15.4**,   (b) **9.5**,   (c) **depends on**

(10) (a) **0.002**,   (b) **reject**,   (c) (iii) MS_{BET} is small and MS_W is large.