STATS KEY

STATS 200 EXAM 1 READ WARNING in middle of page! Oct 2, 2019

PRINT Last Name____________________ **PRINT** First Name____________________

Net ID____________________ Signature ________________________

Instructions- This is a closed book, closed notes exam. You have 1.5 hours to complete it.

- **Print your last and first name, then fill in your Net ID, and signature.**
- **At the end of this exam, you must return this exam with all pages, and ~~you must return~~ your scantron sheet. Please circle all of your answers on this exam and fill in all of your answers on the scantron.**
- **If you do not turn in a complete exam and scantron form, you will receive the grade AB (Absent) for this exam.**
- Use a **#2 pencil. Each question has only *one* answer**. If you bubble in more than one answer it will automatically be marked wrong. Erase mistakes completely.
- This exam is **either Form A, B, C.** You don't know which test form you have so you MUST turn in your scantron with the exam so the TAs can correctly mark the test form box on your scantron sheet after the exam.

How to fill out the Scantron form

- Print and bubble in your **LAST NAME with no spaces or dashes** starting in the left most column. Print your **FIRST INITIAL** in the right-most column.
- Print and bubble in your Student ID number (UIN) with in the Student Number box.
- Print and bubble in the date in the Date box.

WARNING!

⇒

- **Print and bubble in your NET ID with NO SPACES or DASHES in the NETWORK ID box. ** (2 point penalty if you don't bubble in your NET ID correctly.)****
- Print and bubble in the Section Box. See section codes →.
- *Write Stat 200* on the COURSE line.
- *Write your instructor's name* on the INSTRUCTOR line.
- *Write your section on the SECTION line.*

Section Codes:

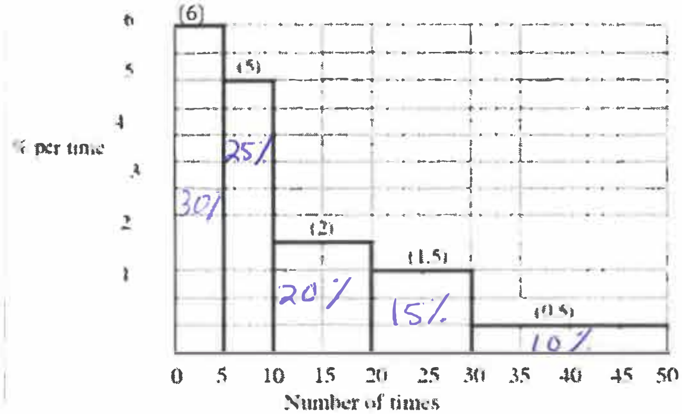
ONL (Fireman) = 00001
L1 (Fireman TR 9:30am) = 00002
S1 (Yu MWF 10am) = 00003
S2 (Chakrabarty MWF 1pm)= 00004
S3 (Liu MWF 9am)= 00005
S4 (Zhou TR 2pm) = 00006

- **Sign your name, and right underneath the student signature line PRINT your name**

Warning -All Cheating including being caught with a non-permissible calculator or formula sheet will result in a 0 and an academic integrity violation on your University record.

CHECK NOW THAT YOU HAVE COMPLETED ALL OF THE STEPS. Before starting the exam, check to make sure that your test booklet is complete. You should have **9 pages (62 problems)**, including **3 tables**: the normal table, the *t*-table, and the chi-square table. If you need scratch paper, ask proctor.

The next 5 questions pertain to the histogram below.
Pretend the figure below is a histogram for the number of times students skipped class in Stat 100. The height of each block is given in parentheses. Assume an even distribution within each interval.



1) What percent of the students fall in the 0-5 block ? **a)** 10% **b)** 15% **c)** 20% **d)** 25% **e)** 30%

2) The median is closest to … **a)** 5 **b)** 6 **c)** 9 **d)** 15 **e)** 20
bc 50% of area is to the left of 9

3) The median is ___<___ the average. **a)** less than **b)** greater than **c)** equal to **d)** cannot be determined
long right hand tail so avg > med

4) The 75th percentile is **a)** 5 **b)** 20 **c)** 30 **d)** 40 **e)** 45
bc 75% of area is to the left of 20

The next 2 questions pertain to a list of 5 numbers with the following deviations from the average: 1, 1, 1, 1 -4

5) One of the deviations is missing, what is it? **a)** -4 **b)** -1 **c)** 2 **d)** 3 **e)** 4
sums to 0

6) What's the SD of the 5 numbers? **a)** 1 **b)** 2 **c)** 3 **d)** 4 **e)** 5
$\sqrt{\frac{1^2+1^2+1^2+1^2+4^2}{5}} = \sqrt{\frac{20}{5}} = 2$

The next 6 questions pertain to a machine that contains 6 fair dice-- 3 red, 2 blue and 1 green. The machine shakes up the dice and then randomly rolls one out at a time, **without** replacement (so each is equally likely to land 1, 2, 3, 4 , 5 or 6.)

7) What's the chance that the machine first rolls out a red?
a) 1/6 **b)** 2/6 **c)** 3/6 **d)** 1/36 **e)** 2/36

8) What's the chance that the machine first rolls out a red **and** it lands 2? $P(R) \times P(2) = \frac{3}{6} \cdot \frac{1}{6} = \frac{3}{36}$
a) 2/6 **b)** 3/6 **c)** 3/36 **d)** 1/36 **e)** 2/36

9) What's the chance that the machine first rolls out a green **or** a 5? $P(G) + P(5) - P(Both)$
a) 2/6 – (1/6*1/6) **b)** 3/6 **c)** 3/6 –(2/6*1/6) **d)** 2/6 * 1/6
$\frac{1}{6} + \frac{1}{6} - \left(\frac{1}{6} \cdot \frac{1}{6}\right)$

10) What's the probability that the first 3 rolls are **all red**? (Remember it's without replacement.)
a) 1– (3/6 *2/5*1/4) **b)** 1– $(1/6)^3$ **c)** 3/6 *2/5*1/4 **d)** $(3/6)^3$ **e)** $(1/6)^3$

11) What's the probability that the first 3 rolls are **not all red**? P(Not All) = 1 - P(All)
a) 1– (3/6 *2/5*1/4) **b)** 1– $(1/6)^3$ **c)** 3/6 *2/5*1/4 **d)** $(3/6)^3$ **e)** $(1/6)^3$

12) What's the probability that **at least one** of the first 3 rolls is a 5? P(At least one) = 1 - P(None)
a) 1/6 + 1/6 +1/6 **b)** 1– $(1/6)^3$ **c)** 1– $(1/6)^3$ **d)** 1– $(5/6)^3$ **e)** $(5/6)^3$

The next 6 questions pertain to the following: Are artificial sweeteners harmful? To find out a study tracked 3,000 adults for 10 years and found those who reported drinking 1 or more artificially sweetened beverages (ASBs) a day were significantly more likely to suffer a stroke and dementia than those who reported consuming no ASBs.

13) Which of the following best describes this study?
- **a)** A randomized controlled experiment.
- **b)** An ~~observational~~ study with controls.
- **c)** A non-randomized experiment with historical controls.

14) Which conclusion is best?
- **a)** This shows that ASBs are *associated with but could not* possibly *cause* stokes and dementia.
- **b)** This is strong evidence that drinking artificial sweeteners *cause* an increased risk of strokes and dementia.
- **c)** This only shows that ASBs *are associated with* increased rates of strokes and dementia: it doesn't show whether or not the ASBs actually *cause* the increased risk.

15) The study said that they controlled for physical activity to eliminate its possible confounding effect. How did they do that?
- **a)** Throughout the study they eliminated participants who did not keep up a healthy level of physical activity.
- **b)** At the beginning of the study they blocked on physical activity before random assignment to the ASB group or no ASB group.
- **c)** At the end of the study, they stratified on physical activity, and compared the stroke and dementia rates of ASB drinkers to non-ASB drinkers within each physical activity level (low activity, moderate activity, and high activity).

Identify whether the following are possible confounders, causal links, or neither. ***Assume only the given information.***

16) Genetics- Some subjects may be more genetically prone to strokes and dementia than others.
a) Confounder **b)** Causal Link **c)** Neither

ASB ? $\boxed{\text{Genetics}}$ → strokes + dementia

17) Chemicals in ASBs may alter gut bacteria leading to cognitive decline and stroke.
a) Confounder **b)** Causal Link **c)** Neither

drink ASB → $\boxed{\text{chemicals change bacteria}}$ → stroke + demen

18) Diabetes – Diabetes causes vascular problems that lead to stroke and dementia, and diabetes causes people to drink ASBs to limit their sugar intake. **a)** Confounder **b)** Causal Link **c)** Neither

drink ASB ← $\boxed{\text{diabetes}}$ → strokes + dementia

Questions 19-20 Do students learn better in Stat 200 in- person sections or in Stat 200 online sections? Last fall we compared the grade distributions of the two groups and found no significant differences. observational

19) Can we conclude that it doesn't matter which section students choose to enroll in, they'll do equally well in either one?
- **a)** No, since students themselves chose which section to enroll in there may be other differences between the 2 groups that are confounding the results. If the 2 groups are unbalanced to begin with, balanced results at the end are not conclusive.
- **b)** Yes, since everything is exactly the same between the two sections (same homework, same exams, etc.) except for the treatment (whether you're watching the lectures in class or online), there are no confounders.
- **c)** Yes, as long as everyone in the in-person sections attended class regularly the conclusion is valid. But not everyone did, so the results are likely to be biased against the in class section.

20) We decide to do a small, randomized experiment with only 40 students. We randomly assign 20 students to attend a short stats lecture in-person and 20 to watch the same lecture online and then give both groups the same quiz and compare results. But immediately after we do the randomization we notice that just by the luck of the draw, the in-person group ended up with many more boys than the online group. What should we do?

- **a)** Randomization doesn't work with small sample sizes, it's better to try to match the groups as much as possible by choosing the groups.
- **b)** Move the extra boys to the other group so that both have the same percentage of boys.
- **c)** Keep the randomized groups, there's always going to be more boys in one group since there's more boys in Stat 200.
- **d)** Redo the randomization but this time block first by randomly selecting half the boys to the in-person group and half to the online. Do the same with the girls.

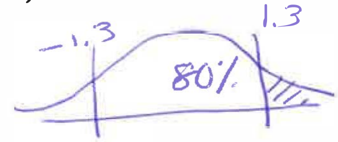
In small ~~to~~ randomized exp, block first then randomize to ensure balanced groups

The next 3 questions pertain to the following: Math SAT scores are **normally distributed** with an **average = 500 and a SD = 100** **(Use the normal table at the end of this exam to answer these questions.)**

21) About what percentage of those who take the SAT score over 630?

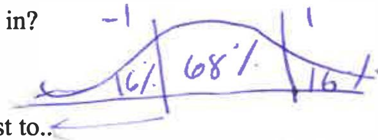
a) 10% b) 20% c) 80% d) 90%

$Z = \frac{630-500}{100} = 1.3$



22) If someone scores 1 SD below average what percentile are they in?

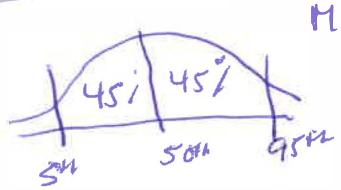
a) 51^{st} b) 68^{th} c) 84^{th} d) 16^{th} d) 49^{th}



loc of typo we accepted c or d

23) If someone scores in the 95^{th} percentile, their SAT score is closest to..

a) 585 b) 560 c) 630 d) 665 e) 700

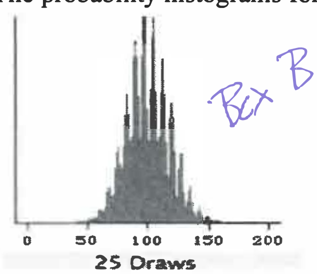


Middle Area = 90%
Z = 1.65
500 + 1.65 (100)
665

The next 2 questions pertain to the 3 boxes and probability histograms below.
25 draws are made at random with replacement from each of the 3 boxes below.

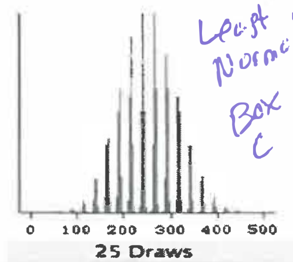
Box A	Box B	Box C
1 2 3	1 2 9	1 2 27

The probability histograms for the sums are shown below in scrambled order:



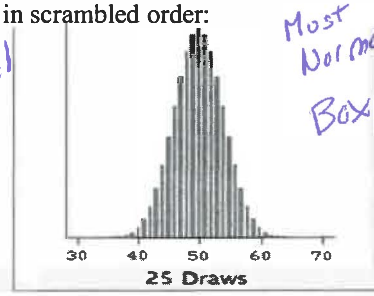
Box B

Histogram 1



Least Normal
Box C

Histogram 2



Most Normal
Box A

Histogram 3

24) Histogram 1 is the probability histogram for the sum of 25 draws from… **a)** Box A **b)** Box B **c)** Box C

25) Histogram 3 is the probability histogram for the sum of 25 draws from… **a)** Box A **b)** Box B **c)** Box C

The next 6 questions pertain to the following poll:
In 2015 a CBS News poll asked a random sample of about 1,000 adults nationwide the following question:
"Do you think that the use of marijuana should be made legal or not?" 31 % answered "Yes"
During the same week in 2015, the same question was asked on the website www.legalize.com where anyone who wants to can cast a vote. About 100,000 people voted on the site and **91%** answered "Yes".

26) Which poll gives a better estimate of what all US adults thought about legalizing marijuana at that time?

a) The CBS poll because the people were *randomly* selected
b) The legalize.com poll because it was 100 times larger.
c) The two polls will have about the same degree of accuracy because the advantages and disadvantages of each will balance out. The advantage of large size is offset by the disadvantage of selection bias for one poll while the advantage of random selection is offset by the disadvantage of small size for the other.

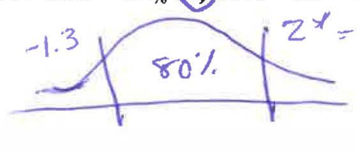
The next 3 questions pertain only to the CBS poll described above.
27) What is the SE of the percentage of YES's in the CBS poll?

a) $\frac{\sqrt{.31 * .69}}{\sqrt{1,000}} x100\%$ **b)** $\sqrt{.31 * .69}\,\%$ **c)** $\sqrt{1000}\sqrt{.31 * .69}\ \%$ **d)** Not possible to compute a SE for this sample.

SE%

28) An 80% confidence interval for the % of all American adults who would answer "Yes" to this question is about

a) 31% ± 2 * $SE_{\%}$ **b)** 31% ± 1.65 * $SE_{\%}$ **c)** 31% ± 1.3 * $SE_{\%}$ **d)** Not possible to compute a confidence interval from this sample



$Z^* = 1.3$

80% CI = sample % ± 1.3 $SE_{\%}$

City A has **1 million** people and City B has **9 million** people. In a pre-election poll a simple random sample of **1000** people is taken from each city.

29) Other things being equal the sample from City A is _______ the sample from city B

a) 9 times more accurate than **b)** 3 times more accurate than **c)** about the same accuracy as bc same $n = 1{,}000$

d) 9 times less accurate than **e)** 100 times less accurate than

The next questions refer to this situation: Joe the talking crow is reputed to be a genius. To test that claim I asked Joe 36 true-false questions. Joe correctly answered 24 of the 36 questions. The null hypothesis is that Joe is just guessing and the alternative is that Joe is doing *better* than chance.

$\boxed{1 \; 0}$ avg $= 1/2$

30) Which of the following most accurately describes the null box?

$SD = \sqrt{1/2 \cdot 1/2} = 1/2$

$n = 36$ w.r.

a) It has 36 tickets, 24 marked "1" and 12 marked "0"
b) It has 36 tickets marked either "1" or "0" but the exact percentage of each is unknown.
c) It has 2 tickets, 1 marked "1" and 1 marked "0"

$EV_{sum} = 36 \cdot 1/2 = 18$

$SE_{sum} = \sqrt{36} \times \frac{1}{2} = 3$

31) The draws are made _________ replacement a) with b) without

$Z = \frac{24-18}{3} = \frac{6}{3} = 2$

32) Assuming the null hypothesis to be true you'd expect Joe to get ______questions correct
a) 0 **b)** 18 **c)** 32 **d)** 38 **e)** 50

33) with a SE = _______. **a)** 0.5 **b)** 2 **c)** 3 **d)** 4 **e)** 5

34) The Z -statistic for testing the null hypothesis is **a)** 1 **b)** 1.5 **c)** 2 **d)** 2.5 **e)** 3

The next 5 questions pertain to the following:
Suppose that a university claims that the average GPA for their graduating seniors is **3.0**. To test this claim I randomly sample 6 graduating seniors. The average GPA of the 6 seniors is **2.8** with a SD of **0.2**.

exp n obs

35) Assume the scores of the thousands of graduating seniors are normally distributed. What test statistic should I use?
a) The t-statistic since I do not know the SD of the thousands of graduating seniors
b) The z-statistic since I know the scores are normally distributed
c) The chi-square statistic since I am sampling one group of graduating seniors
d) None of the above

36) What is the SE$^+$ of the sample average?

$SE^+ = \frac{SD}{\sqrt{n-1}} = \frac{0.2}{\sqrt{6-1}}$

a) $\frac{0.2}{\sqrt{3}}$ b) $\frac{0.2}{\sqrt{4}}$ c) $\frac{0.2}{\sqrt{5}}$ d) $\frac{0.2}{\sqrt{6}}$

37) If you used the t-test, how many degrees of freedom would there be? $n-1 = 6-1$
a) 3 **b)** 4 **c)** 5 **d)** 6 **e)** 7

38) Assume the t-test yielded a t-statistic= -2.24, then the p-value for a 1-sided test is closest to:
a) 25% **b)** 9% **c)** 4% **d)** 1% **e)** 0.5%

2.24 is between 2.5% and 5% on t-table

39) If I knew the SD of all the thousands of graduating seniors, in addition to the information given above, then which test statistic should I use? **a)** z-statistic **b)** t-statistic **c)** chi-square statistic

Never use t when SD is known.
You can use Z bc you know pop is Normal
(so even a sample size of n = 1 would have a normal distribution)

The next questions 4 questions pertain to this survey: A nation-wide random sample of 750 male and 750 female factory workers were asked if they had ever been injured at work. **35%** of the males but only **30%** of the females answered "Yes". Is the 5% difference in the sample large enough to reflect a real difference in the population or is it just due to chance?

40) Which of the following most accurately describes the null box(es)?

- **a)** There are 2 null boxes, each with millions of tickets. One box has 35% "1"s, and the other has 30% "1"s.
- **b)** There are 2 null boxes, each with 750 tickets marked with "0"s and "1"s.
- **c)** There are 2 null boxes, each with millions of tickets, and each with the same percentage of "1"'s.

41) Assuming the null to be true, the SE for the men's sample percentage is about 1.74% and the SE for the women's sample percentage is about 1.67%. The SE for the difference of the 2 sample percentages is closest to …

a) 0% **b)** 3.41% **c)** 1.74% **d)** 1% **e)** 2.41%

$\sqrt{1.74^2 + 1.64^2} = 2.41$

42) The Z statistic for testing the null hypothesis is closest to …
a) 0.5 **b)** 1.07 **c)** 0 **d)** 2.07 **e)** 3

$5/2.41 = 2.07$

43) Suppose the p-value is 2% what do you conclude (assume significance level of 5%)?

- **a)** Cannot reject the null. It's plausible that there is no male/female difference on this question among US adults
- **b)** Reject the null and conclude that there is strong evidence that our sample difference reflects a real male/female difference among US adults.

The next 6 questions pertain to this situation: The M&M company claims that 24% of their milk chocolate candies are blue and 20% are orange; the remaining 56% are a mixture of non-Illini colors (and that deviations from those percents in their packages are just to due random chance). To test their claim I bought 1000 M&M's candies. Here are the results:

Color	Percents Claimed by M&M	*Observed #*	*Expected #*	*Obs -Exp*	*(Obs-Exp)²*	$\frac{(Obs - Exp)^2}{Exp}$
Blue	24%	200	240	-40	1600	1600/240
Orange	20%	240	200	40	1600	8
Non-Illini Colors	56%	560	560	0	0	0
Total	100%	1000	1000	0		

44) To test the null hypothesis that our observed data fits the color percents claimed by the company we'd do the ..
a) 1 sample z test b) 2 sample Z test c) chi-square test for "goodness -of-fit" d) chi-square test for independence

C is correct answer

45) The table above is missing all 3 expected values, which of the following is the correct expected column?

a)	**b)**	**c)**	**d)**
24	333.3	240	200
20	333.3	200	240
56	333.3	560	560

46) How many degrees of freedom? a) 1 b) 2 c) 3 d) 4 e) 5

cat -1 = 3-1 = 2

47) The value for Orange is missing in the *Obs –Exp* column, it should be... **a)** 0 **b)** -40 **c)** 40 **d)** not enough info

48) To compute the proper test statistic you'd have to sum the 3 values in the last column. The term for blue is missing what should it be? **a)** -1600/200 **b)** -1600/240 **c)** 1600/200 **d)** 1600/240 **e)** cannot be determined

49) **The** P-value is less than 1%, what do you conclude?

- **a)** Cannot reject the null because P < 1%
- **b)** Accept the null and conclude that it's quite plausible that the company is making the color percents it claims.
- **c)** Reject the null and conclude there is strong evidence that the company is not making the color percents it claims.

The next 4 questions pertain to a Stat 200 survey on gay marriage:
The table below shows the survey responses of male and female students from last fall's Stat 200 class to the question: "Do you believe gay men and gay women should be allowed to legally marry?"

	Yes	No	Unsure	Total
Male	101	41	23	165
Female	299	56	48	403
Total	400	97	71	568

50) Which significance test should we use to test the null hypothesis that Stat 200 males and females hold essentially the same views on this question, and the observed differences are just due to chance?

a) 1sample z test **b)** 2 sample z test **c)** t-test **d)** χ^2 chi-square test for independence **e)** χ^2 chi-square test for goodness-of-fit

51) How many degrees of freedom are there? **a)** 1 **b)** 2 **c)** 3 **d)** 4 **e)** 5 $(2-1)(3-1) = 2$

52) Assuming the null hypothesis is true, what is the expected number of males who would answer "Yes"?

a) $\frac{403\times400}{568}$ **b)** $\frac{403\times97}{568}$ **c)** $\frac{403\times71}{568}$ **d)** $\frac{165\times97}{568}$ **e)** $\frac{165\times400}{568}$

$\frac{\text{row total} \times \text{column total}}{\text{overall total}}$

53) If the "unsure" category was eliminated so everyone answered either "Yes" or "No", what significance test(s) could be used? a) Only a chi-square test for independence b) Only a 2 sample z test c) Either one

The next 5 questions pertain to significance tests:
A significance test is performed to analyze the results of a randomized experiment to see if some drug worked. Subjects are randomly assigned to treatment and control. The null and alternative hypotheses are the usual:

H_0: The difference in cure rates between the drug and the placebo = 0
H_A: The difference in cure rates between the drug and the placebo > 0

54) Suppose the null is true, what's the chance the researchers are going to make the wrong decision if they set the null cut-off at 2%? **a)** 0% **b)** 1% **c)** 2% **d)** 5% **e)** not enough info

55) Suppose the null is false, what's the chance the researchers are going to make the wrong decision if they set the null cut-off at 1%? **a)** 0% **b)** 1% **c)** 2% **d)** 5% **e)** not enough info

56) A significance test is a statistical check to see whether a difference is due to some real cause or simply due to chance variation. **a)** True **b)** False

57) A statistically significant result means that the result is of social or scientific importance **a)** True **b)** False

58) The reason a p-value of 5% is used as a dividing line to determine statistical significance is because the normal curve has a steep decline at that point (In other words, the curve resembles the edge of a cliff at 5%). **a)** True **b)** False

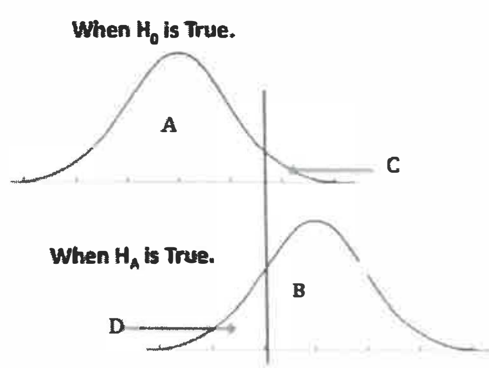
The next 4 questions pertain to the histograms below and Type I and Type II errors.

59) Type I errors (α) correspond to Area **a)** A **b)** B **c)** C **d)** D

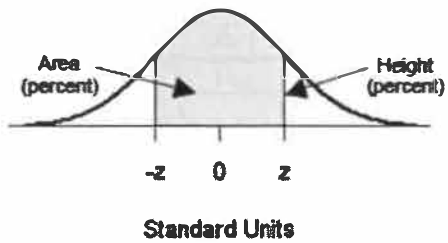
60) Type II errors (β) correspond to Area **a)** A **b)** B **c)** C **d)** D

61) Power corresponds to Area **a)** A **b)** B **c)** C **d)** D

62) If we adjust the null cut-off to decrease the probability of a Type I error what happens to the probability of Type II error?
a) Increases **b)** Decreases **c)** Stays the Same

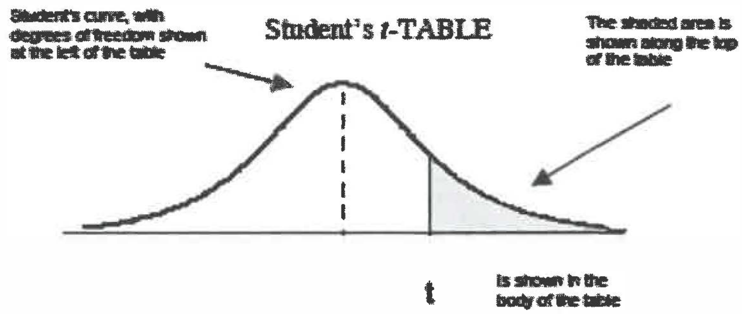


STANDARD NORMAL TABLE



z	Area		z	Area		z	Area
0.00	0.00		1.50	86.64		3.00	99.730
0.05	3.99		1.55	87.89		3.05	99.771
0.10	7.97		1.60	89.04		3.10	99.806
0.15	11.92		1.65	90.11		3.15	99.837
0.20	15.85		1.70	91.09		3.20	99.863
0.25	19.74		1.75	91.99		3.25	99.885
0.30	23.58		1.80	92.81		3.30	99.903
0.35	27.37		1.85	93.57		3.35	99.919
0.40	31.08		1.90	94.26		3.40	99.933
0.45	34.73		1.95	94.88		3.45	99.944
0.50	38.29		2.00	95.45		3.50	99.953
0.55	41.77		2.05	95.96		3.55	99.961
0.60	45.15		2.10	96.43		3.60	99.968
0.65	48.43		2.15	96.84		3.65	99.974
0.70	51.61		2.20	97.22		3.70	99.978
0.75	54.67		2.25	97.56		3.75	99.982
0.80	57.63		2.30	97.86		3.80	99.986
0.85	60.47		2.35	98.12		3.85	99.988
0.90	63.19		2.40	98.36		3.90	99.990
0.95	65.79		2.45	98.57		3.95	99.992
1.00	68.27		2.50	98.76		4.00	99.9937
1.05	70.63		2.55	98.92		4.05	99.9949
1.10	72.87		2.60	99.07		4.10	99.9959
1.15	74.99		2.65	99.20		4.15	99.9967
1.20	76.99		2.70	99.31		4.20	99.9973
1.25	78.87		2.75	99.40		4.25	99.9979
1.30	80.64		2.80	99.49		4.30	99.9983
1.35	82.30		2.85	99.56		4.35	99.9986
1.40	83.85		2.90	99.63		4.40	99.9989
1.45	85.29		2.95	99.68		4.45	99.9991

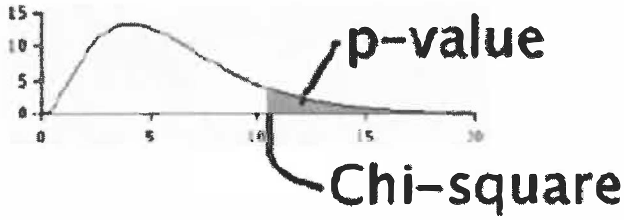
Student's *t*-TABLE



Degrees of freedom	*25%*	*10%*	*5%*	*2.5%*	*1%*	*0.5%*
1	1.00	3.08	6.31	12.71	31.82	63.66
2	0.82	1.89	2.92	4.30	6.96	9.92
3	0.76	1.64	2.35	3.18	4.54	5.84
4	0.74	1.53	2.13	2.78	3.75	4.60
5	0.73	1.48	2.02	2.24 2.57	3.36	4.03
6	0.72	1.44	1.94	2.45	3.14	3.71
7	0.71	1.41	1.89	2.36	3.00	3.50
8	0.71	1.40	1.86	2.31	2.90	3.36
9	0.70	1.38	1.83	2.26	2.82	3.25
10	0.70	1.37	1.81	2.23	2.76	3.17
11	0.70	1.36	1.80	2.20	2.72	3.11
12	0.70	1.36	1.78	2.18	2.68	3.05
13	0.69	1.35	1.77	2.16	2.65	3.01
14	0.69	1.35	1.76	2.14	2.62	2.98
15	0.69	1.34	1.75	2.13	2.60	2.95
16	0.69	1.34	1.75	2.12	2.58	2.92
17	0.69	1.33	1.74	2.11	2.57	2.90
18	0.69	1.33	1.73	2.10	2.55	2.88
19	0.69	1.33	1.73	2.09	2.54	2.86
20	0.69	1.33	1.72	2.09	2.53	2.85
21	0.69	1.32	1.72	2.08	2.52	2.83
22	0.69	1.32	1.72	2.07	2.51	2.82
23	0.69	1.32	1.71	2.07	2.50	2.81
24	0.68	1.32	1.71	2.06	2.49	2.80
25	0.68	1.32	1.71	2.06	2.49	2.79

$$\chi^2 = \Sigma \text{ (obs-exp)}^2/\text{exp}$$

Chi-Square Table



Degrees of freedom ↓	30%	10%	5%	1%	0.1%	← p-value
1	1.07	2.71	3.84	6.63	10.83	
2	2.41	4.61	5.99	9.21	13.82	
3	3.66	6.25	7.81	11.34	16.27	
4	4.88	7.78	9.49	13.28	18.47	
5	6.06	9.24	11.07	15.09	20.52	
6	7.23	10.64	12.59	16.81	22.46	
7	8.38	12.02	14.07	18.48	24.32	
8	9.52	13.36	15.51	20.09	26.12	
9	10.66	14.68	16.92	21.67	27.88	
10	11.78	15.99	18.31	23.21	29.59	
11	12.90	17.28	19.68	24.72	31.26	
12	14.01	18.55	21.03	26.22	32.91	
13	15.12	19.81	22.36	27.69	34.53	
14	16.22	21.06	23.68	29.14	36.12	← Chi-square
15	17.32	22.31	25.00	30.58	37.70	
16	18.42	23.54	26.30	32.00	39.25	
17	19.51	24.77	27.59	33.41	40.79	
18	20.60	25.99	28.87	34.81	42.31	
19	21.69	27.20	30.14	36.19	43.82	
20	22.77	28.41	31.41	37.57	45.31	
21	23.86	29.62	32.67	38.93	46.80	
22	24.94	30.81	33.92	40.29	48.27	
23	26.02	32.01	35.17	41.64	49.73	
24	27.10	33.20	36.42	42.98	51.18	