# STP 231 Statistics for Life Science Majors

**Instructor** **Print Name**_____

**Form A** Solution

## Honor Statement:

**By signing below you confirm that you have neither given nor received any unauthorized assistance on this exam. This includes any use of a graphing calculator beyond those uses specifically authorized by the Mathematics Department and your instructor. Furthermore, you agree not to discuss this exam with anyone until the exam testing period is over. In addition, your calculator's memory and menus may be checked at any time and cleared by any testing center proctor or Mathematics Department instructor.**

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**Signature** **Date**

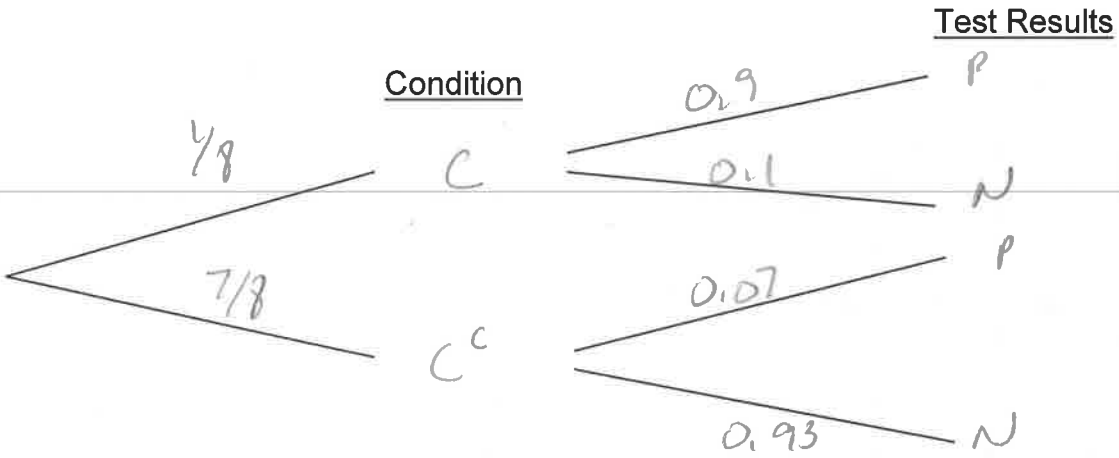
***Read the instructions carefully:***

- Read all the questions carefully and make sure you answer the question asked.
- The formula sheet is on the last page
- **Short Answer**
  - Solve the problems in the manner that is requested. Show all work. **If no supporting work is shown then the problem will receive a 0. If you think it, then write it.**
  - **Points are marked for each problem**
- **Multiple Choice**
  - **Showing and explaining your work will help you come to a correct answer. I will check to see that work was shown.**
  - Circle your correct answer and fill in the letter in the table on the back of this page 3.
  - **Multiple choice problems 8-17 are worth 6 points each and 18-20 are worth 5 points each.**
- **Total Number of points is 102**
- You may use a calculator as long as it contains no inappropriate material in the memory. Calculators that have a computer algebra system are prohibited.
- ****TURN OFF YOUR CELL PHONE/PAGER**. IF YOUR PHONE IS OUT DURING THE EXAM, YOU WILL RECEIVE A 0 ON THE EXAM.**
- There are 12 pages and 20 numbered questions worth a total of 102 points.

**No calculator that does symbolic algebra may be used.**
**Casio FX2 , TI-89, and TI-92 calculators or ones with QWERTY keyboards are not allowed!**
**No graphing calculator programs may be used.**

**Brain Dump**

**For Part I – Free Response. Show all work (as described on page 1) (15 points)**
Suppose 1 in 8 women will be diagnosed during her lifetime with breast cancer. 90% of the women will have a positive mammogram given that they have breast cancer. Suppose that the women does not have breast cancer, there is a 93% chance that she will have a negative mammogram. Fill out the tree diagram with the appropriate information




1. What is the probability that a woman will have a positive mammogram and will have breast cancer?

$$Pr(C \text{ and } P) = 1/8 \cdot 0.9$$
$$= 0.1125$$

2. What is the probability that a woman will have a positive mammogram?

$$Pr(P) = Pr(C \text{ and } P) + Pr(C^c \text{ and } P)$$
$$= 1/8 \cdot 0.9 + 7/8 \cdot 0.07$$
$$= 0.1125 + 0.06125 = 0.1735$$

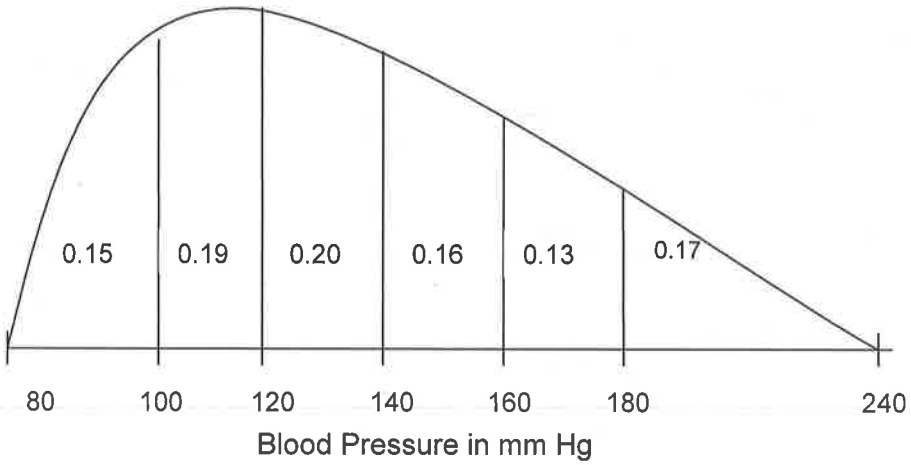
3. What is the probability that a woman will not have breast cancer given that she had a positive mammogram?

$$Pr(C^c \mid P) = \frac{Pr(C^c \text{ and } P)}{Pr(P)}$$
$$= \frac{0.06125}{0.1735}$$
$$= 0.3525$$

**Use the following density curve that represents the distribution of systolic blood pressures in a population of middle-aged men Suppose a man is selected at random from the population and let $Y$ be his blood pressure. (12 points)**

Use the density curve below to find the probabilities:

Systolic Blood Pressure in Middle-Aged Men




4. Find the probability that the systolic blood pressure of a man is at least 160 mm Hg.

$Pr(160 < Y) = 0.13 + 0.17 = 0.30$

5. Find $\Pr(Y < 120 \text{ mm Hg})$.

$Pr(Y < 120) = Pr(80 < Y < 100) + Pr(100 < Y < 120)$

$= 0.15 + 0.19 = 0.34$

6. If a random sample of two men is taken what is the probability that both men have systolic blood pressures more than 180 mm Hg?

$Y_1$ blood pressure for man 1

$Y_2$ blood pressure for man 2

$Pr(Y_1 > 180 \text{ and } Y_2 > 180) = Pr(Y_1 > 180) \cdot Pr(Y_2 > 180)$

$= 0.17 \cdot 0.17 = 0.0289$

7. If a random sample of two men is taken, what is the probability that exactly one man has blood pressure more than 180 mm Hg and one man has blood pressure less than 100 mg Hg?

$Y_1$ blood pressure for man 1

$Y_2$ blood pressure for man 2

$Pr(BP > 180) = 0.17$ $Pr(BP < 100) = 0.15$

(1st man low and 2nd High) or 1st man high and 2nd low

$Pr(\text{one man BP high and one man BP low}) = Pr(Y_1 > 180 \text{ and } Y_2 < 100) + Pr(Y_1 < 100 \text{ and } Y_2 > 180)$

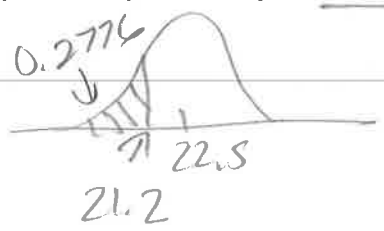
$= (0.17 \cdot 0.15) + (0.15 \cdot 0.17)$

$= 0.051$

**Part 2 Multiple Choice**

**Use the following information for answering the questions below:**
**The data for this example is for the full grown dog breed known as the Beagle (think Snoopy). The weight of this breed is normally distributed with a mean of 22.5 pounds and a standard deviation of 2.2 pounds. Use this information to answer questions 3-6**

8. Compute the probability that a dog will weigh **less than** 21.2 pounds

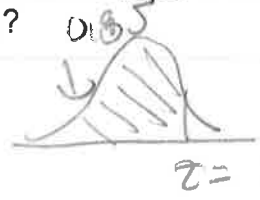



$$z = \frac{21.2 - 22.5}{2.2}$$

$$z = -0.59$$

A 0.2776 B 0.7224 C 0.59 D 0.41 E None of the Above

9. If the veterinarian reports that a Beagle dog was at the 85th percentile for his weight, how much did he weigh?




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

$$1.04 = \frac{y - 22.5}{2.2}$$

$$24.7881\text{bs} = y$$

A. 20.21 lbs B. 24.27 lbs C. 24.79 lbs D. 23.73 lbs E. None of these

10. If **four** Beagle dogs are randomly selected what is the probability that **the sample mean** $\bar{y}$ of the four, Beagle dogs are between 20.5 pounds and 24.5 pounds?


$$z = \frac{20.5 - 22.5}{\frac{2.2}{\sqrt{4}}}$$

$$z = -1.82$$

$$z = \frac{24.5 - 22.5}{\frac{2.2}{\sqrt{4}}}$$

$$z = 1.82$$

Area between = 0.9656 − 0.0344

= 0.9312

A. 0.6372 B. 0.9312 C. 0.8186 D. 0.9656 E. None of these

11. 68.26% of the Beagle dogs weight between 20.3 and 24.7 lbs. If four Beagle dogs are selected at random, then what is the probability that three out of the four dogs weigh between 20.3 and 24.7 pounds?

Binomial

$$Pr(Y=3) = {}_4C_3 \cdot (0.6826)^3 (1-0.6826)^{4-3}$$

$$= 4 \cdot 0.31805 \cdot 0.3174 = 0.403799$$

A. 0.0873 B. 0.0101 C. 0.2171 D. 0.4038 E. None of these

Part 2 Multiple Choice

**Circle your answer choice on the exam AND fill in the answer with the correct letter.**

| Problem Number | Letter of Answer |
|---|---|
| 8. | |
| 9 | |
| 10. | |
| 11. | |
| 12. | |
| 13. | |
| 14. | |
| 15 | |
| 16. | |
| 17. | |
| | |
| 18 | |
| 19 | |
| 20 | |

**Use the following information for problems 12-14**

**The number of cigarettes that twelfth graders smoked in the past 30 days as reported by the National Institute on Drug Abuse is shown below. $Y$ is the number of cigarettes smoked in per day. Use the following table to find the answers for problems 7, and 8**

| Cigarettes per day | Percentage |
|---|---|
| None | 73.3 |
| Some, but less than 1 | 9.8 |
| 1-5 | 7.8 |
| 6-14 | 5.3 |
| 15-25 | 2.8 |
| 26-34 | 0.7 |
| 35 or more | 0.3 |
| Total= | 100 |

12. Find the probability that, within the last 30 days, a randomly selected twelfth grader smoked between 6 and 34 cigarettes per day? inclusive

$$Pr(6 \le Y \le 34) = \frac{5.3 + 2.8 + 0.7}{100} = \frac{8.8}{100} = 0.088$$

A 0.166 B 0.088 C 0.081 D 0.035 E None of the Above

13. What percentage of twelfth graders smoked less than 1 cigarette per day

$$Pr(Y \le 1) = 73.3 + 9.8 = 83.1$$

A 73.3% B 9.8% C 83.1% D 63.5% E None of the Above

14. Suppose $\mu_Y = 1.688$ cigarettes and $\sigma_Y = 4.934$ cigarettes. If we take a sampling distribution of this data with samples of 50 twelfth graders in each, then distribution shape of $\overline{Y}$ is?

A approximately normal B right skewed C left skewed D None of the Above

**Use the following information for problems 15-17**
**Is the duration of a cold influenced by whether medication is taken or not?**

| | | Medicine Taken | | |
|---|---|---|---|---|
| Cold Length | | Yes | No | Total |
| | 1-3 days | 86 | 19 | 105 |
| | 4-7 days | 16 | 79 | 95 |
| | Total | 102 | 98 | 200 |

CL = cold length
m = medicin taken

15. Find the probability that the person has a cold lasting 1-3 days

$$Pr(1 \le CL \le 3) = \frac{105}{200}$$

A. $\frac{86}{200}$ B. $\frac{105}{200}$ C. $\frac{180}{300}$ D. $\frac{86}{105}$ E. None of these

16. Find the probability that the person has a cold lasting 4-7 days given that they have not taken medicine

$$Pr(4 \le C \le 7 \mid m^c) = \frac{79}{98}$$

A. $\frac{79}{98}$ B. $\frac{79}{95}$ C. $\frac{95}{200}$ D. $\frac{98}{200}$ E. None of these

17. Find the probability that the person has a cold lasting 1-3 days or has taken medicine.

$$Pr(1 \le CL \le 3 \text{ or } m) = Pr(1 \le CL < 3) + Pr(m) - Pr(1 \le CL < 3 \text{ and } M)$$

$$= \frac{105}{200} + \frac{102}{200} - \frac{86}{200} = \frac{121}{200}$$

A. $\frac{121}{200}$ B. $\frac{86}{102}$ C. $\frac{293}{300}$ D. $\frac{86}{200}$ E. None of these

**Short Answer**

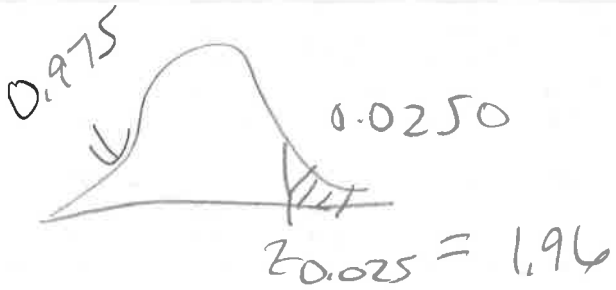
18. In reference to sample sizes and the sampling error, the large the sample size, the smaller the sampling error tends to be in estimating a population mean $\mu$ by a sample mean $\bar{y}$

A True B False

19. After performing a normal probability plot, if our data appears to be skewed, then we can transform the data by using a transformation such as the square root, or the log.

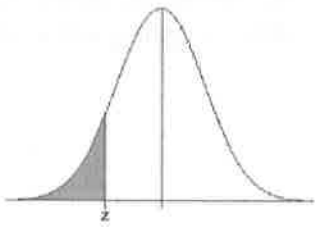
A True B False

20. What is the value of $z_{0.025}$?




A. -1.645 B. -1.96 C. 1.645 D. 1.96 E. None of these

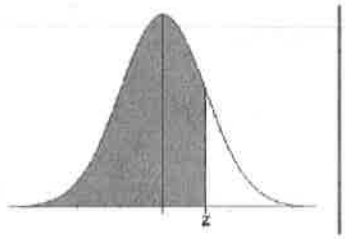
## Standard Normal Cumulative Probability Table




**Cumulative probabilities for NEGATIVE z-values are shown in the following table:**

| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| -3.4 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0002 |
| -3.3 | 0.0005 | 0.0005 | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0003 |
| -3.2 | 0.0007 | 0.0007 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0005 | 0.0005 | 0.0005 |
| -3.1 | 0.0010 | 0.0009 | 0.0009 | 0.0009 | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0007 | 0.0007 |
| -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 |

## Standard Normal Cumulative Probability Table




**Cumulative probabilities for POSITIVE z-values are shown in the following table:**

| z | 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 |
| **3.2** | 0.9993 | 0.9993 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9995 | 0.9995 | 0.9995 |
| **3.3** | 0.9995 | 0.9995 | 0.9995 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9997 |
| **3.4** | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9998 |

# Formulas

## Probability

$\Pr(E^c) = 1 - \Pr(E)$

$\Pr(E_1 or\ E_2) = \Pr(E_1) + \Pr(E_2) - \Pr(E_1 and\ E_2)$ For any two probabilities

$\Pr(E_1 \mid E_2) = \dfrac{\Pr(E_1 and\ E_2)}{\Pr(E_2)}$ For any two probabilities

$\Pr(E_1 and\ E_2) = \Pr(E_1) \times \Pr(E_2)$ For any two independent probabilities

## Binomial Probability

$${}_nC_j = \frac{n!}{(n-j)!\,j!} \qquad \Pr(Y = j) = {}_nC_j \cdot p^j (1-p)^{n-j}$$

## Random Variables

$$\mu_Y = \Sigma[y_i \times \Pr(Y = y_i)] \qquad \sigma_Y = \sqrt{\Sigma\left[(y_i - \bar{y})^2 \times \Pr(Y = y_i)\right]}$$

## Descriptive Measures

$$\bar{y} = \frac{\Sigma y}{n} \qquad z = \frac{y-\mu}{\sigma}$$

$$\mu = \frac{\Sigma y}{N} \qquad \sigma = \sqrt{\frac{(y_i - \bar{y})^2}{n}}$$

## Sampling Distribution of the Sample Mean

$$\mu_{\bar{y}} = \mu$$

$$\sigma_{\bar{y}} = \frac{\sigma}{\sqrt{n}} \qquad z = \frac{\bar{y} - \mu}{\frac{\sigma}{\sqrt{n}}}$$