

Please place your name legibly at the top and the first letter of your last name in the box. (1 pt)
Put your calculator's number on the blank below the box. (1 pt)
Written answers should be concise.
Final answers should be copied into blanks provided where designated. _____

MULTIPLE CHOICE (2 pts each)

(1) On July 14 I showed a figure representing box office totals for 5 movies - you may remember my comparison of "Twilight Eclipse" to "Away From Her" and "Let the Right One In.". The data figure I showed is best described as which of the following types of figures?

- (A) Bar chart (B) Histogram (C) Pie chart (D) Box plot (E) Scatterplot

(2) The proportion of observations in a data set that are less than Q3 is:

- (A) 25% (B) 33% (C) 50% (D) 66% (E) 75%

(3) The proportion of observations that lie between Q1 and the median is:

- (A) 100% (B) 75% (C) 50% (D) 25% (E) 0%

(4) Which of the following is FALSE for a binomial distribution with $p=0.2$?

- (A) Distribution is skewed left. (D) Mean is larger than the median.
(B) Distribution is skewed right. (E) Median is smaller than the mean.
(C) Distribution is not symmetric.

(5) Which is the best definition of "independent" events.

- (A) A and B are independent if $p(B) = p(A|B)$
(B) A and B are independent if $p(B) = p(B|A)$
(C) A and B are independent if $p(B) = p(A)$
(D) A and B are independent if $p(B) + p(A) = 1$
(E) A and B are independent if $p(B) \times p(A) = 1$

For the next two questions consider a pair of data sets, A and B, with the same mean.

Data set A has a skewness of 0.75 and an excess kurtosis of 1.7.

Data set B has a skewness of -0.33 and an excess kurtosis of 4.1.

(6) Which of the following statements is FALSE?

- (A) The median of data set A is larger than the median of data set B.
(B) The median of data set A is smaller than the median of data set B.
(C) The median of data set A is smaller than the mean of data set B.
(D) The median of data set B is larger than the mean of data set A.
(E) Data set A is right skewed, but data set B is left skewed.

(7) Which of the following statements is TRUE?

- (A) Both data sets are right skewed and leptokurtic.
(B) Data set A is platykurtic while data set B is leptokurtic.
(C) Data set A is right skewed and leptokurtic.
(D) Data set B is right skewed and leptokurtic.
(E) Both data sets are platykurtic.

(8) Which of the following is the most robust, in terms of repeated samples usually providing similar values, measurement of the spread of a data set?

- (A) Variance (B) Standard deviation (C) Range (D) Median (E) IQR

For the next two questions consider a situation in which you take repeated samples from a population that does not include outliers and has a platykurtic distribution.

(9) If you compare the means, medians and modes of the samples, which of the following statements is the best description of the relative variability of those three values?

- (A) The mean is more variable than the mode and median.
- (B) The mode is more variable than the mean and median.**
- (C) The median is more variable than the mode and mean.
- (D) The mode and mean don't vary much, but the median does.
- (E) The mode and median don't vary much, but the mean does.

(10) If you compare the IQRs, mid-ranges and variances the samples, which of the following statements is the best description of the relative variability of those three values?

- (A) The IQR is more variable than the range and variance.
- (B) The range is more variable than the IQR and variance.**
- (C) The variance is more variable than the IQR and range.
- (D) The IQR and range don't vary much, but the variance does.
- (E) The IQR and variance don't vary much, but the range does.

(11) Consider a situation in which you are sampling (with replacement) from a population and keeping track of several statistics as you go. Which of the following is an accurate description of how certain values would change as your sample size increases?

- (A) The range goes up and down, but the variance either stays the same or increases.
- (B) The range goes up and down, but the variance either stays the same or decreases.
- (C) The variance goes up and down, but the range either stays the same or increases.**
- (D) The variance goes up and down, but the range either stays the same or decreases.
- (E) Both values go up and down.

(12) A doctor is interested in the probability that people visiting his hospital have blood pressures above 140/90, but doesn't have time to look at all the records so he goes to the filing cabinet and gets 50 medical records from the last week's visitors. He takes the 50 files back to his office and records the values in these files. Which of the following is the best description of his sampling procedure?

- (A) He sampled non-randomly and without replacement.**
- (B) He sampled non-randomly and with replacement.
- (C) He sampled randomly and without replacement.
- (D) He sampled randomly and with replacement.
- (E) He sampled according to the Poisson method.

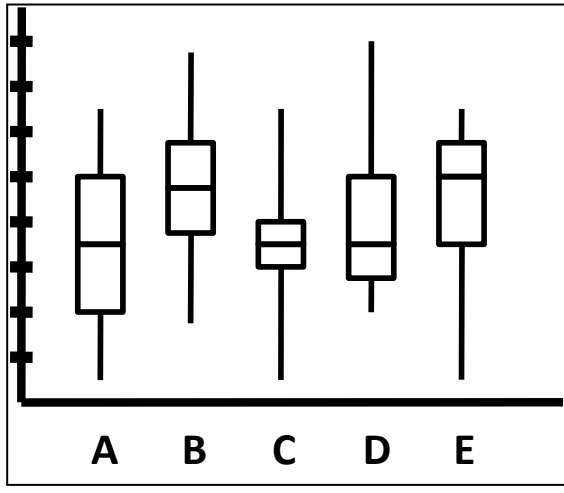
(13) Which of the following is true for a data set exhibiting a Poisson distribution?

- (A) Distribution exhibits independence.
- (B) Distribution is symmetric.
- (C) Mean and variance are equal.**
- (D) Median and mean are equal.
- (E) Median and variance are equal.

(14) Which if the following best described the Moire effect?

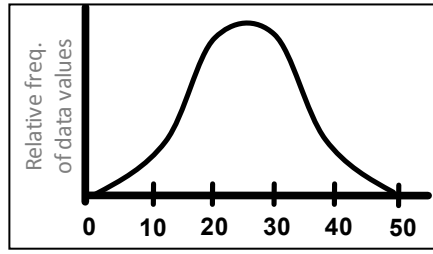
- (A) When redder colors represent larger values.
- (B) The distortion of area caused by representing objects in 3D instead of 2D.
- (C) The bias that arises from sampling without replacement.
- (D) The visual distortion caused by sets of closely packed parallel lines.**
- (E) The reason the binomial distribution turns into the Poisson distribution.

For the next 4 questions use the figure shown to the right that visually summarizes five data sets. For each question choose the letter choice of the data set that best matches the description. Note: choices may be used more than once.

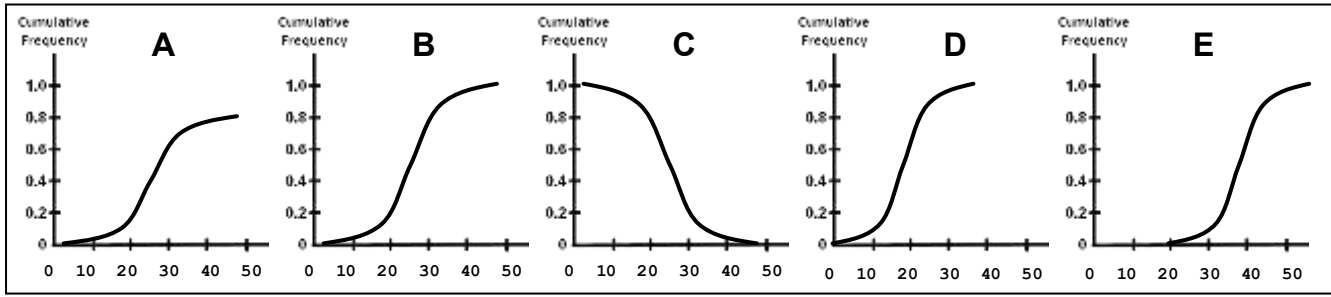


- (15) This data set has the largest mean. **B**
- (16) This data set has the smallest IQR. **C**
- (17) This data set is skewed left. **E**
- (18) This data set is the one that most likely exhibits a platykurtic distribution. **A**
- (19) Which data set has a unique value of Q3? **C**

(20) Which of the indicated cumulative probability plots below best represents the probability frequency distribution shown at the right?



B



(21) Which of the following is the mathematical representation of the complementation rule?

- (A) $p(A) + p(B) = 1$
- (B) $p(A) = 1 - p(B)$
- (C) $p(A) = p(A|B)$
- (D) $p(A) = p(\neg A)$
- (E) $p(A) + p(\neg A) = 1$**

(22) Which of the following is the best definition of "independent" events?

- (A) A and B are independent if $p(A) = p(B)$
- (B) A and B are independent if $p(A) + p(B) = 1$
- (C) A and B are independent if $p(A) \times p(B) = 1$
- (D) A and B are independent if $p(A) = p(A|B)$**
- (E) A and B are independent if $p(A) = p(B|A)$

(23) Which of the following is the best definition of "mutually exclusive" events?

- (A) A and B are mutually exclusive if $p(A \text{ and } B) = 0$**
- (B) A and B are mutually exclusive if $p(A \text{ and } B) = 1$
- (C) A and B are mutually exclusive if $p(A \text{ or } B) = 0$
- (D) A and B are mutually exclusive if $p(A \text{ or } B) = 1$
- (E) A and B are mutually exclusive if $p(A \text{ and } B) = p(A \text{ or } B)$

(24) Which of the following is NOT an assumption required in order for a distribution of observations to have a binomial distribution?

- (A) Each trial is independent of all others.
- (B) The probability of success is 0.5.**
- (C) Results of trials can be defined to have only two possibilities.
- (D) The probability of observing results doesn't change over time.
- (E) There are a known number of trials.

(25) Which of the following was NOT discussed as a technique that can be used to manipulate a person looking at your figure?

- (A) Alter the scale of axes in your plots to magnify differences between values.
- (B) Error bars should be omitted in order to make data values appear accurate.
- (C) Simplify the figure by eliminating superfluous pictures and symbols.**
- (D) Graphics can be used to generate emotional impact.
- (E) Use 3D plots to alter perceived differences between values.

(26) This plotting technique shows the frequencies of observations in each set of several qualitatively defined categories, all observations are represented such that the frequencies sum to 100%

- (A) Bar chart
- (B) Boxplot
- (C) Histogram
- (D) Pie chart**
- (E) XY plot

(27) Jabba the Hutt is hungry and snacks by dipping his hand into a jar containing squishy and crunchy critters and eating them one by one. If he eats a total of 12 critters and 5 were crunchy, how many different ways could he have done this (e.g., the first 5 were crunchy, the first 7 were squishy, etc.)

- (A) 24
 - (B) 420
 - (C) 240
 - (D) 972
 - (E) 792**
-

27. For the questions below, use the SAMPLE of data shown to the right that was taken from a population with unknown properties.

3	4	8	5
4	9	7	5
10	6	4	7

(a, 2 pts each) Using the values from the data above calculate the indicated values and fill in the blanks to the right. (unless noted otherwise, provide all answers to the nearest 0.01)

- First Quartile (Q1) = _____
4
- Third Quartile (Q3) = _____
7.5
- Mean = _____
6
- Median = _____
5.5
- Mode = _____
4
- Interquartile range (IQR) = _____
3.5
- Variance = _____
4.91

28 (2 pts each) For the following questions consider a population of 600 data values that exhibits a normal distribution with a mean of 50 and standard deviation of 6. (unless noted otherwise, provide all answers to the nearest 0.01)

- (a) What is the Z-score for a value of 60? Z = _____
1.67

- (b) How many of the data values do you expect to be less than or equal to 47? (round to the nearest whole number) # = _____
185

- (c) What is the Z score for the value that is larger than 91% of the data? Z = _____
1.34

- (d) What percentage of the values do you expect to lie between 48 and 58? % = _____
between 53.75 and 54.30

- (e) What is the variance of the population? var = _____
36

29. (2 pts each) For the following 3 questions consider a situation in which we are studying the number of birds that utilize an environmentally sensitive region in a forest. A series of motion sensor activated cameras are set up and they record birds as they fly across the region. The partially completed table to the right shows how often certain numbers of observations were seen over a number of nights (unless otherwise noted, report all answers to nearest 0.001) (2 pts each)

<u># sightings</u>	<u>Frequency</u>
0	0.0819
1	0.2049
2	0.2561
3	0.2134
4	?
5	0.0667
6	0.0278
7	0.0099

(a) What is the mean number of birds seen flying by the sensor per hour?

mean = _____
2.500

(b) What is the probability of our camera recording 4 flights in an hour?

$p(4) =$ _____
0.133

(c) What is the probability that our camera records 7 or more flights in an hour?

$p(7+) =$ _____
0.016

(d) The problems on this page use the Poisson distribution, describe the relationship between the binomial distribution and the Poisson distribution.

The binomial becomes the Poisson when the probability of success is small and the number of trials is very large.

(e) Testing a distribution of data to see whether it is Poisson very easy; describe a special feature of the Poisson distribution that makes such a test so easy?

The mean and variance should be equal.

30. (2 pts each) Consider a large population of birds in which 80% have red bills and 20% have green bills. This population is large enough that you can consider all samples to be sampling with replacement. (unless otherwise noted, report all answers to nearest 0.001)

What is the probability that you catch three random birds and all three have red bills?

$$p(3R) = \underline{\hspace{2cm}} \\ 0.512$$

What is the probability of catching a pair of random birds and they have the same color bills?

$$p(\text{same}) = \underline{\hspace{2cm}} \\ 0.680$$

What is the probability that you catch 11 random birds and get 8 with red bills and 3 with green bills?

$$p(8R,3G) = \underline{\hspace{2cm}} \\ 0.221$$

If you were to take a series of samples of 30 birds and measure the number of birds with red bills in each, what would you expect the mean of the set of those values to be?

$$\text{mean} = \underline{\hspace{2cm}} \\ 24$$

If you were to take a series of samples of 30 birds and measure the number of birds with red bills in each, what would you expect the standard deviation of the set of those values to be?

$$\text{SD} = \underline{\hspace{2cm}} \\ 2.191$$

Based on your previous two answers what is the range of values which you would expect to see for 95% of your samples? (report values to nearest 0.1)

$$\text{From } \underline{\hspace{2cm}} \text{ to } \underline{\hspace{2cm}} \\ 19.62 \qquad 28.38$$

TABLE OF Z SCORES

Table of probabilities of the standard normal distribution. Table shows the probability that a standard normal variate will have a value less than or equal to z.

z	0	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	0.017	0.0166	0.0162	0.0158	0.0154	0.015	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	0.063	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	0.123	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	0.209	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	0.305	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
0.0	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

