Name: Key **Math 127 Exam 2 Summer 2014**

Oath: ***"I will not discuss the exam contents with anyone until it is returned to me by my instructor"***

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Every question is worth 3 points, except those marked * are worth 2 points.

1. The diameters of Papa John's Large pizzas follow N(14.20", 0.20"). Large pizzas are advertised to have a diameter of 14".

1a*. 0.159 What percentage of pies are actually under the advertised size?

1b*. 0.067 What is the probability that your next pizza is over 14.5" in diameter?

1c. 14.305" Determine the 70th percentile for diameter.

1d. 0.118 If you buy four pizzas, determine the probability that all four are between 13.75" and 14.25". Show calculation.

$P(13.75 < x < 14.25) = 0.586$

$P(\text{all 4}) = (0.586)^4 = 0.118$

1e. 0.500 If you buy four pizzas, determine the probability that at least one of them is below the advertised size. Show calculation.

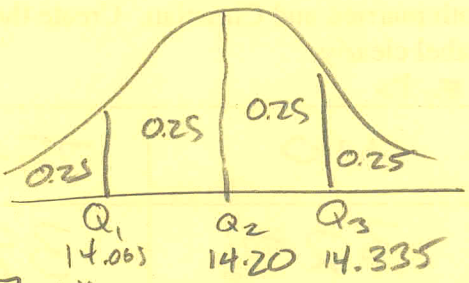
$P(\text{under } 14") = 0.159$

$P(\text{over } 14") = 0.841$

$P(\text{at least one under}) = 1 - P(\text{all 4 over})$

$= 1 - (0.841)^4 = 0.4997$

1f. 0.27 Determine the IQR for this distribution. Show calculation.



$IQR = Q_3 - Q_1$

$= 14.335 - 14.065$

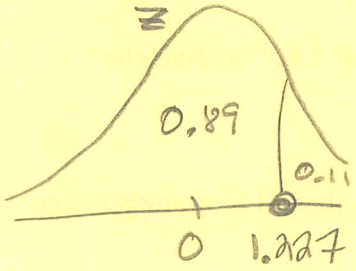
$= 0.27$

1g. 14.714" If a pizza is known to have a z-score = 2.57, what was the diameter? Show calculation.

$$2.57 = \frac{y - 14.20}{0.20}$$

$y =$

2. Papa John's Extra Large pizzas have diameters that follow a Normal model, but the mean diameter is unknown. We know that 11% of pizzas are 16.5" or bigger. The standard deviation is 0.30". Find the mean, show work.



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

$$1.227 = \frac{16.5" - \mu}{0.30"}$$

$$\mu = 16.1319"$$

3. Suppose the time between arrivals to the Cecil College registration desk follows an Exponential probability distribution with a mean time of 7 minutes and a standard deviation of 7 minutes.

3a. Determine the first and third quartiles of this distribution. Then determine the IQR. Show work.

$Q_1 = 2.014$

$Q_3 = 9.704$

$IQR = 9.704 - 2.014$

$= 7.69$ mins

3b*. P(Next arrival within 2 minutes) = 0.249

3c*. P(Next arrival longer than 30 minutes) = 0.014

4. Suppose that 20% of Cecil College students are married, 39% of Cecil College students are Christian, and 7% of Cecil College students are both married and Christian. Create the 2 by 2 contingency table using the above information. Label clearly.

	MARRIED		
Christians ↓	YES	NO	TOTAL
YES	7%	32%	39%
NO	13%	48%	61%
TOTAL	20%	80%	100%

5. Use the "**Neighborhood**" dataset to answer the following questions. We will use "***Square Footage"*** of homes to predict the "***Assessed***" values of homes. "***Assessed***" value is the dollar value that property taxes are based on.

5a. Describe the relationship between the two variables, hitting all the important points and including a measure of strength in your write up.

_____

_____

_____

_____

5b. Determine the best-fitting linear equation for this dataset. Explain why the y-intercept is meaningless in the context of this problem.

Equation: _____

y-intercept: _____

_____

5c. Interpret the value of the slope with a sentence in context. _____

_____

_____

5d. Interpret the value of R^2 with a sentence in context. _____

_____

_____

5e. Interpret the value of s_e with a sentence in context. _____

_____

_____

5f. Identify any homes by row that have large Studentized residuals (what is large?):

_____

5g. Identify any homes by row that have large Cook's distances (what is large?):

_____

5h. One house was forgotten to be included in the list. 200 Friendship is 2205 square feet. Predict its "***Assessed***" value using the model. If its actual "***Assessed***" value is $233,900, determine the value of the residual.

Predicted value: _____

Residual: _____

5i. Interpret the value of the residual for 306 Hermitage.

Residual: _____

Interpretation: _____

_____

_____

5j. The correlation is clearly statistically significant. ***If*** you were to run the randomization test to confirm this:

Null Hypothesis: _____

Alternative Hypothesis: _____

6. At Cecil College, presume that 89.3% of our students have smart phones. We will randomly sample $n = 25$ students.

6a. P(Everyone has a smart phone) = $x = 25$ 0.059

6b. P(At least 90% of the sample has a smart phone) = $x \geq 23$ 0.490

6c. Why is it not appropriate to use the Normal approximation for this Binomial problem? _____

$np = 22.325$ ✓ $n(1-p) = 2.675 < 10$ ✗

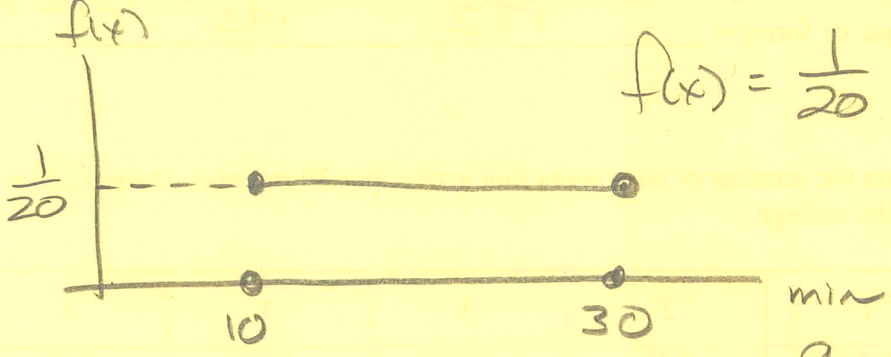
6d. Determine the mean and standard deviation for this probability distribution:

Mean: $\mu = np = 22.325$

Standard Deviation: $\sigma = \sqrt{25(0.893)(0.107)} = 1.546$

7. Suppose the length of piano sonatas from the Romantic era follow a Uniform distribution on the interval [10, 30] in minutes.

7a. Draw the probability distribution graph and give the probability function:



$f(x) = \frac{1}{20}, \quad 10 \leq x \leq 30$

7b. What percentage of sonatas last at least 21 minutes? $\frac{9}{20} = 0.45$

7c. Determine the 45th percentile for this probability distribution. 19 mins

$(.45)(20) = 9$

$10 + 9 = 19$

8. Use the following table to answer the following questions. Give fractions and then decimal answers rounded to three decimals if appropriate.

Contingency table results:
Rows: Born in USA
Columns: How Religious

	Extremely religious	Not religious	Somewhat religious	Very religious	Total
No	0	1	6	1	8
Yes	5	39	55	25	124
Total	5	40	61	26	132

8a*. P(Born in USA | Extremely Religious) = $\frac{5}{5} = 1$, 100%

8b*. P(Somewhat religious | Not Born in USA) = $\frac{6}{8} = 0.75$

8c*. P(Born in USA and Very Religious) = $\frac{25}{132} = 0.189$

8d*. P(Religious in any way, shape, or form) = $\frac{5+61+26}{132} = \frac{92}{132} = 0.697$

9. The following table represents the number of customers that arrive, per 30 minutes, at that coffee place across the street from the college.

Number of Customers	0	1	2	3	4	5
Probability	0.10	0.30	0.30	0.20	0.05	0.05

9a. P(At most 2 customer) = $0.10+0.30+0.30 = 0.70$

9b. P(At least 2 customers) = $0.30+0.20+0.05+0.05 = 0.60$

9c. Determine the expected number of customers. Show work.

$\mu = 0(0.10) + 1(0.30) + 2(0.3) + 3(0.2) + 4(0.05) + 5(0.5)$

$= 1.95$

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1. The diameters of Papa John's Large pizzas follow N(14.15", 0.25"). Large pizzas are advertised to have a diameter of 14".

1a*. 0.274 What percentage of pies are actually under the advertised size?

1b*. 0.081 What is the probability that your next pizza is over 14.5" in diameter?

1c. 14.0189" Determine the 70th percentile for diameter.

1d. 0.130 If you buy four pizzas, determine the probability that all four are between 13.75" and 14.25". Show calculation.

$P(13.75 < x < 14.25) = 0.601$

$P(\text{all four}) = (0.601)^4 = 0.130$

1e. 0.722 If you buy four pizzas, determine the probability that at least one of them is below the advertised size. Show calculation.

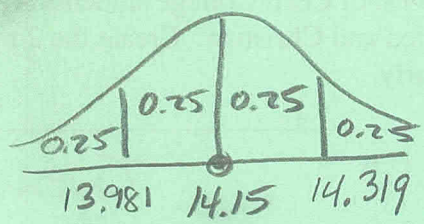
$P(\text{Under } 14") = 0.274$

$P(\text{Over } 14") = 0.726$

$P(\text{at least one under}) = 1 - P(\text{all 4 over})$

$= 1 - (0.726)^4 = 0.722$

1f. 0.338" Determine the IQR for this distribution. Show calculation.



$IQR = Q_3 - Q_1$

$= 14.319 - 13.981$

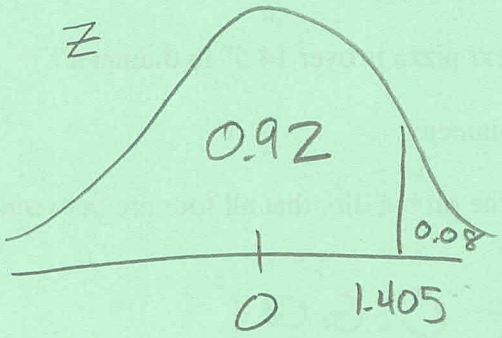
$= 0.338"$

1g. 14.7925" If a pizza is known to have a *z*-score = 2.57, what was the diameter? Show calculation.

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

$$2.57 = \frac{y - 14.15}{0.25} \qquad y = 14.7925"$$

2. Papa John's Extra Large pizzas have diameters that follow a Normal model, but the mean diameter is unknown. We know that 8% of pizzas are 16.5" or bigger. The standard deviation is 0.30". Find the mean, show work.



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

$$1.405 = \frac{16.5-\mu}{0.3}$$

$$\mu = 16.0785"$$

3. Suppose the time between arrivals to the Cecil College registration desk follows an Exponential probability distribution with a mean time of 9 minutes and a standard deviation of 9 minutes.

3a. Determine the first and third quartiles of this distribution. Then determine the IQR. Show work.

$Q_1 = 2.589$

$Q_3 = 12.477$

$IQR = 12.477 - 2.589$

$= 9.888$ mins

3b*. P(Next arrival within 2 minutes) = 0.199

3c*. P(Next arrival longer than 30 minutes) = 0.036

4. Suppose that 14% of Cecil College students are married, 39% of Cecil College students are Christian, and 3% of Cecil College students are both married and Christian. Create the 2 by 2 contingency table using the above information. Label clearly.

MARRIED

CHRISTIANS	YES	NO	TOTAL
YES	3%	36%	39%
NO	11%	50%	61%
TOTAL	14%	86%	100%

5. Use the "**Neighborhood**" dataset to answer the following questions. We will use "***Square Footage"*** of homes to predict the "***Assessed***" values of homes. "***Assessed***" value is the dollar value that property taxes are based on.

5a. Describe the relationship between the two variables, hitting all the important points and including a measure of strength in your write up.

Positive
Linear
Strong, $r = 0.914$
Could argue: 319, 315, 103 Hermitage
327 Outliers

5b. Determine the best-fitting linear equation for this dataset. Explain why the *y*-intercept is meaningless in the context of this problem.

Equation: $\hat{Assessed} = 127{,}112.35 + 50.19\left(\frac{SQ}{FT}\right)$

y-intercept: $X = 0$ SQ. FT. is extrapolation, no home exists, but predicted to assess at \$127,112?

5c. Interpret the value of the slope with a sentence in context. For each extra square foot of living space, we expect "Assessed" value to increase by \$50.19

5d. Interpret the value of R^2 with a sentence in context. 83.63% of the variation in "Assessed" value is explained by knowing a home's square footage.

5e. Interpret the value of s_e with a sentence in context. On average, our predicted "Assessed" values are off by about \$15,101

exceeds ±2

5f. Identify any homes by row that have large Studentized residuals (what is large?):

Rows 18, 19, 29

$\frac{4}{33} = 0.1212$

5g. Identify any homes by row that have large Cook's distances (what is large?):

Rows 18, 32

5h. One house was forgotten to be included in the list. 200 Friendship is 2205 square feet. Predict its "***Assessed***" value using the model. If its actual "***Assessed***" value is $233,900, determine the value of the residual.

Predicted value: $\widehat{Assessed} = \$237,771.11$

Residual: $233,900 - 237,771.11 = -3871.11$

5i. Interpret the value of the residual for 306 Hermitage.

Residual: $e = -3071$

Interpretation: This house assessed for $3071 less than what the model predicts for its size.

5j. The correlation is clearly statistically significant. ***If*** you were to run the randomization test to confirm this:

Null Hypothesis: There is no relationship between x = SQ FT y = Assessed

Alternative Hypothesis: There is a linear relationship between x = SQ. FT and y = Assessed.

6. At Cecil College, presume that 89.3% of our students have smart phones. We will randomly sample $n = 15$ students.

6a. P(Everyone has a smart phone) = $(X=15)$ 0.183

6b. P(At least 90% of the sample has a smart phone) = $(X \geq 14)$ 0.512

6c. Why is it not appropriate to use the Normal approximation for this Binomial problem? $np = 13.395$ ✓ $n(1-p) = 1.605 < 10$ ✗

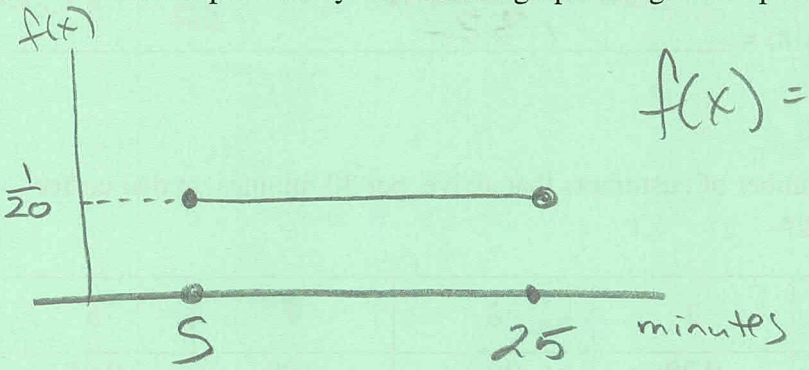
6d. Determine the mean and standard deviation for this probability distribution:

Mean: $\mu = np = 13.395$

Standard Deviation: $\sigma = \sqrt{15(0.893)(0.107)} = 1.197$

7. Suppose the length of piano sonatas from the Romantic era follow a Uniform distribution on the interval [5, 25] in minutes.

7a. Draw the probability distribution graph and give the probability function:



$f(x) = \frac{1}{20}, \quad 5 \leq x \leq 25$

7b. What percentage of sonatas last at least 21 minutes? $\frac{4}{20} = \frac{1}{5} = 0.2$

7c. Determine the 45th percentile for this probability distribution. 14 minutes

$(0.45)(20) = 9$

$5 + 9 = 14$

8. Use the following table to answer the following questions. Give fractions and then decimal answers rounded to three decimals if appropriate.

Contingency table results:
Rows: Born in USA
Columns: How Religious

	Extremely religious	Not religious	Somewhat religious	Very religious	Total
No	0	1	3	1	5
Yes	5	42	55	25	127
Total	5	43	58	26	132

8a*. P(Born in USA | Extremely Religious) = $\frac{5}{5} = 1$, 100%

8b*. P(Somewhat religious | Not Born in USA) = $\frac{3}{5} = 0.60$

8c*. P(Born in USA and Very Religious) = $\frac{25}{132} = 0.189$

8d*. P(Religious in any way, shape, or form) = $\frac{5+58+26}{132} = \frac{89}{132} = 0.674$

9. The following table represents the number of customers that arrive, per 30 minutes, at that coffee place across the street from the college.

Number of Customers	0	1	2	3	4	5
Probability	0.05	0.10	0.20	0.30	0.30	0.05

9a. P(At most 2 customer) = $0.05 + 0.10 + 0.20 = 0.35$

9b. P(At least 2 customers) = $0.20 + 0.30 + 0.30 + 0.05 = 0.85$

9c. Determine the expected number of customers. Show work.

$$\mu = 0(0.05) + 1(0.10) + 2(0.20) + 3(0.30) + 4(0.3) + 5(0.05)$$

$$= 2.85$$