THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

ECON1310
Introductory Statistics for Social Sciences

Tutorial 4: PROBABILITY II

Tutor: Francisco Tavares Garcia

CML 01 and CML 02.

CML 1 and 2 Reminder

Posted on: Wednesday, 14 December 2022 09:00:00 o'clock AEST

Dear Students,

A reminder that:

1. **CML 1 (2nd Attempt)** is now open and will **close at 4pm this Friday** (16 December)
2. **CML 2 (1st Attempt)** is now open and will **close at 4pm on Monday 19 December** (Week 4)
3. Please note that you **MUST check, save and submit** your CMLs, are they do not auto-submit.
4. Familiarise yourselves with the **CML Information Sheet** (Assessment > CML Quizzes > CML Administrative Folder), which contains CML **rules**, how questions are marked, and how to access your CML answers (once they have closed) etc.
5. You are now able to **view your answers for CML 1 (1st Attempt)** under 'My Grades' in Blackboard. Page 7 of the CML Information Sheet outlines instructions for this.

Feel free to email me if you have any questions.

Best of luck!

Dominic

LBRT 01 – First week of 2023!

LBRT #1

Type: Online Quiz
Learning Objectives Assessed: 1, 2, 3, 4, 5
Due Date: 03 Jan 23 9:00 - 04 Jan 23 16:00 2nd attempt: 5-6 Jan 2023, 09:00-16:00
Weight: 20%
Reading: 0 minutes
Duration: 90 minutes
Format: Multiple-choice, Problem solving
Task Description:
LBRT #1 will involve solving problems based on the learning materials covered in Lectures 1 to 4 inclusively. This includes all learning materials presented in Lectures 1 to 4 and the associated tutorials, as well as CML1 and CML2. All answers must be entered into Blackboard by the due date and time.

Criteria & Marking:
UQ Students: Please access the profile from Learn.UQ or mySI-net to access marking criteria held in this profile.

Stats from Tutorial 03:

Students attending: **34** (33)

- Students enrolled in this tutorial: **32** (28)
- Students not enrolled: **2** (5) (Welcome!)
  - If you haven't yet, please email d.byrne@uq.edu.au to inform him you would like to attend this tutorial (4 pm).

Poll participation

- Answered all 3+ polls: **15** (27)
- 2 polls: **11** (3) students
- 1 poll: **3** (0) students
- 0 polls: **5** (3) students

Time Spent (total time per student – multiple logins added)

- Max time: **95** (100) minutes (Francisco – 107 min)
- Min time: **23** (10) minutes (does it count as attending?)
- Mean time: **77.88** (82.6) minutes
- Standard deviation: **12.3** (15.7) minutes

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Tutorial 4 – Week 5

PROBABILITY II

At the end of this tutorial you should be able to

- Construct a discrete probability distribution.
- Calculate the mean and variance for a discrete probability distribution.
- Describe the characteristics of a binomial distribution.
- Calculate the probability of a particular outcome of a binomial distribution using a calculator.

Q1. The number of car radios sold each week by a large company has been recorded for the past 100 weeks. No radios have been sold in 3 of the weeks. One radio has been sold in 20 of the weeks. Two radios in 50 of the weeks, three in 20, four in 5 and five in two of the weeks. No more than five radios were sold in any of the past 100 weeks. Construct a probability distribution for the number of car radios sold in a week using the relative frequencies as probabilities. In the long run what is the average and standard deviation of number of car radios sold per week?

(Excel)

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X	P(X)
0	0.03
1	0.2
2	0.5
3	0.2
4	0.05
5	0.02

(Poll)

Q1. The number of car radios sold each week by a large company has been recorded for the past 100 weeks. No radios have been sold in 3 of the weeks. One radio has been sold in 20 of the weeks. Two radios in 50 of the weeks, three in 20, four in 5 and five in two of the weeks. No more than five radios were sold in any of the past 100 weeks. Construct a probability distribution for the number of car radios sold in a week using the relative frequencies as probabilities. In the long run what is the average and standard deviation of number of car radios sold per week?

X	P(X)	Average μ (mu)
0	0.03	0
1	0.2	0.2
2	0.5	1
3	0.2	0.6
4	0.05	0.2
5	0.02	0.1
		2.1

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X	P(X)
0	0.03
1	0.2
2	0.5
3	0.2
4	0.05
5	0.02

Average μ (mu)
0
0.2
1
0.6
0.2
0.1
2.1

Variance σ^2 (sigma squared)
0.1323
0.242
0.005
0.162
0.1805
0.1682
0.89

Q1. The number of car radios sold each week by a large company has been recorded for the past 100 weeks. No radios have been sold in 3 of the weeks. One radio has been sold in 20 of the weeks. Two radios in 50 of the weeks, three in 20, four in 5 and five in two of the weeks. No more than five radios were sold in any of the past 100 weeks. Construct a probability distribution for the number of car radios sold in a week using the relative frequencies as probabilities. In the long run what is the average and standard deviation of number of car radios sold per week?

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0	0.03
1	0.2
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Average μ (mu)
0
0.2
1
0.6
0.2
0.1
2.1

Variance σ^2 (sigma squared)
0.1323
0.242
0.005
0.162
0.1805
0.1682
0.89

Standard Deviation σ (sigma)
0.9434

Q2. A travel company is considering introducing a new package tour. Based on market research, if sales are high, they can make a profit of 107 thousand dollars per year on the new route. Moderate sales would mean they can make $35 thousand, whereas poor sales would imply a loss of $37 thous per year. If the probabilities for the profit scenarios are 0.57 and 0.31, respectively,

a. Determine the expected profit

b. Determine the standard deviation of profit

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a. Determine the expected profit $E(X) = \mu = ?$

b. Determine the standard deviation of profit

(Poll)

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b. Determine the standard deviation of profit

X	P(X)
107	0.57
35	0.31
-37	0.12

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a. Determine the expected profit $E(X) = \mu = 67.4$

b. Determine the standard deviation of profit

X	P(X)
107	0.57
35	0.31
-37	0.12

Average μ (mu)
60.99
10.85
-4.44
67.4

Q2. A travel company is considering introducing a new package tour. Based on market research, if sales are high, they can make a profit of 107 thousand dollars per year on the new route. Moderate sales would mean they can make $35 thousand, whereas poor sales would imply a loss of $37 thous per year. If the probabilities for the profit scenarios are 0.57 and 0.31, respectively,

a. Determine the expected profit $E(X) = \mu = 67.4$

b. Determine the standard deviation of profit $sd(X) = \sigma = \sqrt{\sigma^2} = \sqrt{var(X)} = ?$

X	P(X)
107	0.57
35	0.31
-37	0.12

Average μ (mu)
60.99
10.85
-4.44
67.4

Q2. A travel company is considering introducing a new package tour. Based on market research, if sales are high, they can make a profit of 107 thousand dollars per year on the new route. Moderate sales would mean they can make $35 thousand, whereas poor sales would imply a loss of $37 thous per year. If the probabilities for the profit scenarios are 0.57 and 0.31, respectively,

a. Determine the expected profit $E(X) = \mu = 67.4$

b. Determine the standard deviation of profit $sd(X) = \sigma = \sqrt{\sigma^2} = \sqrt{var(X)} = 50.27$ ($th)

X	P(X)
107	0.57
35	0.31
-37	0.12

Average μ (mu)
60.99
10.85
-4.44
67.4

Variance σ^2 (sigma squared)
893.8512
325.4256
1307.9232
2527.2

Standard Deviation σ (sigma)
50.2713

Q3. (i) It was thought that 32% of people preferred Pepsi to Coke. Thirty-five people participated in a Pepsi versus Coke taste test. Each person was given two samples and asked to say which they preferred.

a) Is this a binomial situation? What are the properties of the binomial distribution?

b) What is the expected number of participants preferring Pepsi?

c) What is the variance of the distribution?

(Poll)

Q3. (i) It was thought that 32% of people preferred Pepsi to Coke. Thirty-five people participated in a Pepsi versus Coke taste test. Each person was given two samples and asked to say which they preferred.

a) Is this a binomial situation? What are the properties of the binomial distribution? Yes

b) What is the expected number of participants preferring Pepsi?

c) What is the variance of the distribution?

1) The trials are identical – each person was given two samples.
2) Two possible outcomes – either Pepsi or Coke.
3) Trials are independent – random people participated.
4) Constant probability – thought that 32% of people preferred Pepsi.

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a) Is this a binomial situation? What are the properties of the binomial distribution? Yes

b) What is the expected number of participants preferring Pepsi?

c) What is the variance of the distribution?

expected number of successes = $E(X) = \mu = ?$

Q3. (i) It was thought that 32% of people preferred Pepsi to Coke. Thirty-five people participated in a Pepsi versus Coke taste test. Each person was given two samples and asked to say which they preferred.

a) Is this a binomial situation? What are the properties of the binomial distribution? Yes

b) What is the expected number of participants preferring Pepsi? 11.2

c) What is the variance of the distribution?

expected number of successes = E(X) = μ = n*p = 35*0.32 = 11.2

Q3. (i) It was thought that 32% of people preferred Pepsi to Coke. Thirty-five people participated in a Pepsi versus Coke taste test. Each person was given two samples and asked to say which they preferred.

a) Is this a binomial situation? What are the properties of the binomial distribution? Yes

b) What is the expected number of participants preferring Pepsi? 11.2

c) What is the variance of the distribution?

expected number of successes = E(X) = μ = n*p = 35*0.32 = 11.2

variance = var(X) = σ^2 = ?

Q3. (i) It was thought that 32% of people preferred Pepsi to Coke. Thirty-five people participated in a Pepsi versus Coke taste test. Each person was given two samples and asked to say which they preferred.

a) Is this a binomial situation? What are the properties of the binomial distribution? Yes

b) What is the expected number of participants preferring Pepsi? 11.2

c) What is the variance of the distribution?

expected number of successes = E(X) = μ = n*p = 35*0.32 = 11.2

variance = var(X) = σ^2 = n*p*q = ?

Q3. (i) It was thought that 32% of people preferred Pepsi to Coke. Thirty-five people participated in a Pepsi versus Coke taste test. Each person was given two samples and asked to say which they preferred.

a) Is this a binomial situation? What are the properties of the binomial distribution? Yes

b) What is the expected number of participants preferring Pepsi? 11.2

c) What is the variance of the distribution? 7.62

expected number of successes = E(X) = μ = n*p = 35*0.32 = 11.2

variance = var(X) = σ^2 = n*p*q = n*p*(1 – p) = 35*0.32*0.68 = 7.62

standard deviation = sd(X) = $\sigma = \sqrt{\sigma^2} = \sqrt{\text{var}(X)}$ = 2.76

Q4. Use your calculator to find (binomial) $P(X=9 \mid n=14, p=0.4)$ and $P(X<3 \mid n=11, p=0.65)$

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Understanding the Binomial Formula

A coin is tossed three times. What is the probability of getting 2 heads?

$$P(X) = {}^{n}C_{X} p^{X} q^{(n-X)}$$

n = 3

p = probability of getting heads = 0.5

X = number of heads = 2

3 combinations of two heads and a tail

$${}^{3}C_{2} = \frac{3*2}{2*1} = 3$$ (use calculator in ECON1310)

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Understanding the Binomial Formula

$$P(X=0) = {}^{3}C_{0} * 0.5^{0} * 0.5^{(3-0)}$$

(no heads) $= 1 * 0.5^{0} * 0.5^{3}$

$= 1 * 1 * (1/2)^{3}$

$= 0.125$

$$P(X=1) = {}^{3}C_{1} * 0.5^{1} * 0.5^{(3-1)}$$

(one head) $= 3 * 0.5^{1} * 0.5^{2}$

$= 3 * 1/2 * 1/4$

$= 3/8 = 0.375$

37

(Excel)

Q4. Use your calculator to find (binomial) P(X=9 | n=14, p=0.4) and P(X<3 | n=11, p=0.65)

Understanding the Binomial Formula

A coin is tossed three times. What is the probability of getting 2 heads?

$$P(X) = {}^{n}C_{X} p^{X} q^{(n-X)}$$

n = 3

p = probability of getting heads = 0.5

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3 combinations of two heads and a tail

$${}^{3}C_{2} = \frac{3*2}{2*1} = 3$$ (use calculator in ECON1310)

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Understanding the Binomial Formula

$$P(X=0) = {}^{3}C_{0} * 0.5^{0} * 0.5^{(3-0)}$$

(no heads) $= 1 * 0.5^{0} * 0.5^{3}$

$= 1 * 1 * (1/2)^{3}$

$= 0.125$

$$P(X=1) = {}^{3}C_{1} * 0.5^{1} * 0.5^{(3-1)}$$

(one head) $= 3 * 0.5^{1} * 0.5^{2}$

$= 3 * 1/2 * 1/4$

$= 3/8 = 0.375$

37

P(X=9 | n=14, p=0.4) =	0.04081	=BINOM.DIST(9,14,0.4, FALSE)
P(X<3 | n=11, p=0.65) =	0.002038	=BINOM.DIST(2, 11, 0.65, TRUE)

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters.

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

(Poll)

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

1) The trials are identical – call three households.
2) Two possible outcomes – close the sale or not.
3) Trials are independent – the outcome of each call is independent of the others.
4) Constant probability – 20% chance of closing a sale on each call.

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

$P(X=x \mid n=3, p=0.2) = ?$

(Excel)

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

Number of sales X	0	1	2	3
P(X)	0.512	0.384	0.096	0.008

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

Number of sales X	0	1	2	3
P(X)	0.512	0.384	0.096	0.008

P(X>1) = ?

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

Number of sales X	0	1	2	3
P(X)	0.512	0.384	0.096	0.008

P(X>1) = P(X >=2) = ?
P(X>1) = 1 – P(X <= 1)

Q5. A life insurance salesman has arranged to call on three households tomorrow. Based on past experience, he feels there is a 20% chance of closing a sale on each call, and that the outcome of each call is independent of the others. Let X represent the number of sales he would close tomorrow.

a. Does this situation satisfy all of the binomial properties? Explain. State the parameters. Yes

b. Determine the probability distribution of X.

c. Find the probability that more than one sale will be closed tomorrow.

Number of sales X	0	1	2	3
P(X)	0.512	0.384	0.096	0.008

P(X>1) = P(X >=2) = 0.096 + 0.008 = 0.104

P(X>1 | n=3, p=0.2) =	0.104	=1 - BINOM.DIST(1, 3, 0.2, TRUE)

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Tutorial 4 – Week 5

PROBABILITY II

At the end of this tutorial you should be able to

- Construct a discrete probability distribution.
- Calculate the mean and variance for a discrete probability distribution.
- Describe the characteristics of a binomial distribution.
- Calculate the probability of a particular outcome of a binomial distribution using a calculator.

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Thank you

Francisco Tavares Garcia

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tavaresgarcia.github.io

Reference

Black et al. (2016), Australasian Business Statistics, 4th Edition, Wiley Australia.