THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

ECON1310
Introductory Statistics for Social Sciences

Tutorial 3: PROBABILITY I

Tutor: Francisco Tavares Garcia

CML 01 and CML 02

ECON1310 - Week 3: CML 1 (1st Attempt) Closing Today

Posted on: Monday, 12 December 2022 06:00:00 o'clock AEST

Dear Students,

A few reminders regarding CMLs:

1. **CML 1 (1st Attempt)** will **close at 4pm** **today** (12 December). Please read the **CML Information Sheet** carefully, especially the CML **rules** (located under the CML Administrative Folder). Remember to **CHECK, SAVE and SUBMIT** your CML before the closing time, as the quiz does NOT auto-submit.
2. You will be able to **view your answers** to CML 1 (1st Attempt) **after the closing time at 4pm today** through the My Grades tab. **Instructions** on how to access your answers are located on page 7 of the CML Information Sheet.
3. **CML 1 (2nd Attempt)** will be **open at 9am this Wednesday** (14 December) and **close at 4pm this Friday** (16 December).
4. **CML 2 (1st Attempt)** will also **open at 9am this Wednesday** (14 December) and **close at 4pm next Monday** (19 December).
5. For a summary of all key dates and times for CMLs and LBRTs, refer to the **Assessment Summary** under the 'Assessment' tab on Blackboard or the ECP [which you can also access via Blackboard]).

Fee free to email me at the CML mailbox (cml.1310@uq.edu.au) if you have any questions regarding CML rules/admin.

Best of luck!

Dominic

Stats from Tutorial 02:

Students attending: **33** (30)

- Students enrolled in this tutorial: **28** (26)
- Students not enrolled: **5** (4) (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 4 polls: **20** (11)
- 3 polls: **7** (6) students
- 2 polls: **3** (7) students
- 1 poll: **0** (4) students
- 0 polls: **3** (2) students

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

- Max time: **100** (110) minutes (not me, Francisco – 97 min)
- Min time: **23** (10) minutes (does it count as attending?)
- Mean time: **82.6** (79.57) minutes
- Standard deviation: **15.7** (24.1) minutes

ECON1310

Tutorial 3 – Week 4

PROBABILITY I

At the end of this tutorial you should be able to

- Define the basic concepts used in simple probability problems.
- Define the four types of probability.
- Use the addition and multiplication rules to calculate various probabilities.
- Construct a contingency table and calculate various probabilities.
- Construct a simple tree diagram and calculate various probabilities.
- Test the independence of events using a contingency table.

Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

a) Are winning a soft drink and large pizza mutually exclusive?
Are winning a soft drink and large pizza collectively exhaustive?
Draw a Venn Diagram.
Draw a joint probability matrix.

b) What is the probability you will win a prize?

c) What is the probability that you will not win a prize?

d) What is the probability that you will not win a prize on three consecutive visits to Tony's?

Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

a) Are winning a soft drink and large pizza mutually exclusive?
Are winning a soft drink and large pizza collectively exhaustive?
Draw a Venn Diagram.
Draw a joint probability matrix.

P(S) = 0.1
P(P) = 0.02

(Poll)

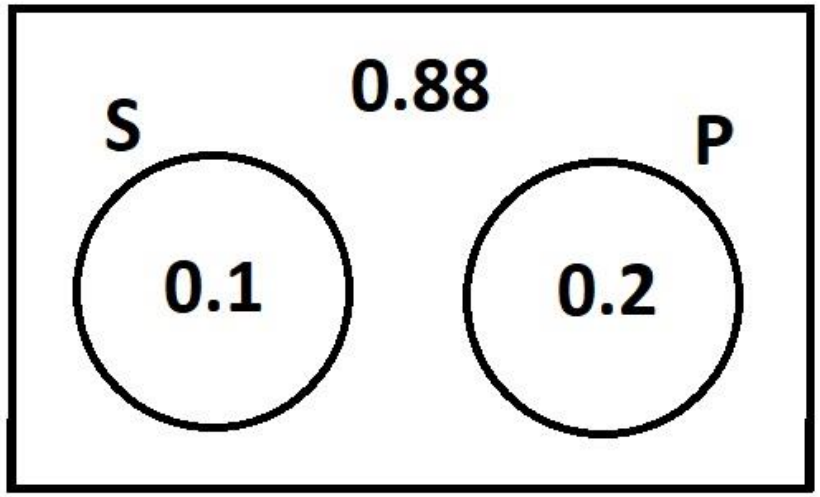
Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

a) Are winning a soft drink and large pizza mutually exclusive? Yes
Are winning a soft drink and large pizza collectively exhaustive? No
Draw a Venn Diagram.
Draw a joint probability matrix.

(Whiteboard)

Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

a) Are winning a soft drink and large pizza mutually exclusive? Yes
Are winning a soft drink and large pizza collectively exhaustive? No
Draw a Venn Diagram.
Draw a joint probability matrix.



	P	P'	Total
S	0	0.1	0.1
S'	0.02	0.88	0.9
Total	0.02	0.98	1

Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

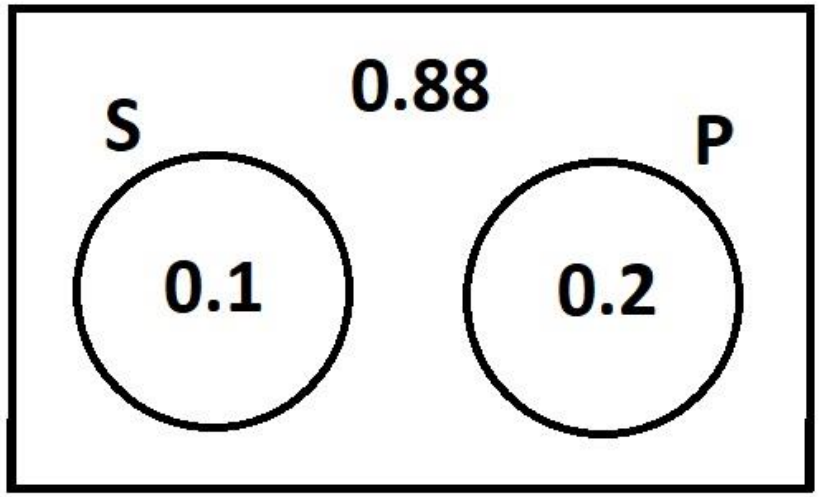
a) Are winning a soft drink and large pizza mutually exclusive? Yes
Are winning a soft drink and large pizza collectively exhaustive? No
Draw a Venn Diagram.
Draw a joint probability matrix.

b) What is the probability you will win a prize?

(Poll)

c) What is the probability that you will not win a prize?

d) What is the probability that you will not win a prize on three consecutive visits to Tony's?



	P	P'	Total
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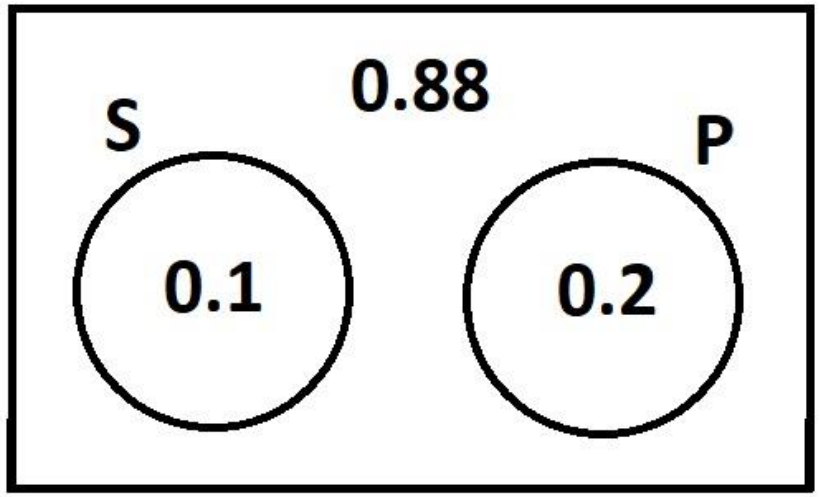
Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

a) Are winning a soft drink and large pizza mutually exclusive? Yes
Are winning a soft drink and large pizza collectively exhaustive? No
Draw a Venn Diagram.
Draw a joint probability matrix.

b) What is the probability you will win a prize? P(W) = P(S or P) = P(S) + P(P) – P(S and P)

c) What is the probability that you will not win a prize? P(W') = 1 – P(W)

d) What is the probability that you will not win a prize on three consecutive visits to Tony's? P(W' ∩ W' ∩ W')



	P	P'	Total
S	0	0.1	0.1
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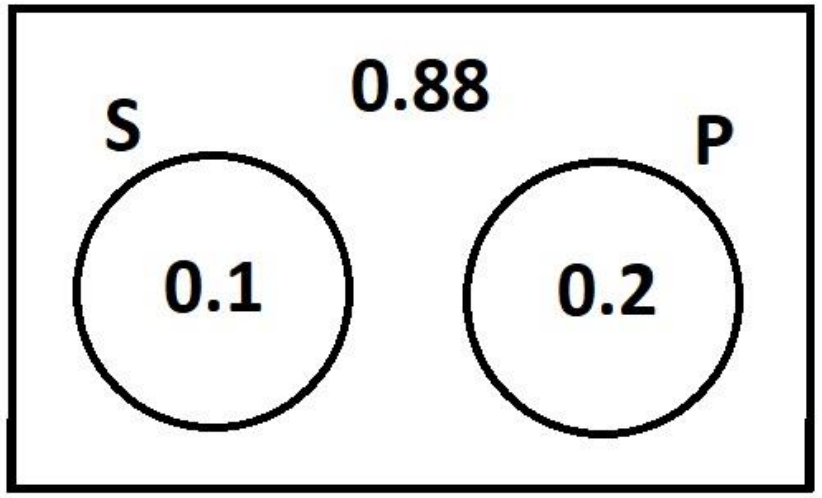
Q1. With each purchase of a large pizza at Tony's Pizza, the customer receives a coupon that can be scratched to see if one prize will be awarded. The chance of winning a free soft drink is 1 in 10, and the chance of winning a free large pizza is 1 in 50. You plan to eat lunch tomorrow at Tony's.

a) Are winning a soft drink and large pizza mutually exclusive? Yes
Are winning a soft drink and large pizza collectively exhaustive? No
Draw a Venn Diagram.
Draw a joint probability matrix.

b) What is the probability you will win a prize? 0.12

c) What is the probability that you will not win a prize? 0.88

d) What is the probability that you will not win a prize on three consecutive visits to Tony's? $0.6815 = (0.88)^3$



	P	P'	Total
S	0	0.1	0.1
S'	0.02	0.88	0.9
Total	0.02	0.98	1

Q2. Fifteen per cent of a new sports car model have defective brakes and defective steering occurs 5% of the time in this model. Assume these problems occur independently. If one or other (but not both) of these problems are present the car is called a 'lemon'. If both problems are present the car is called a 'hazard'. Draw both a Venn diagram and a joint probability table. What is the probability that the car is:

a) a hazard

b) a lemon

(Excel)

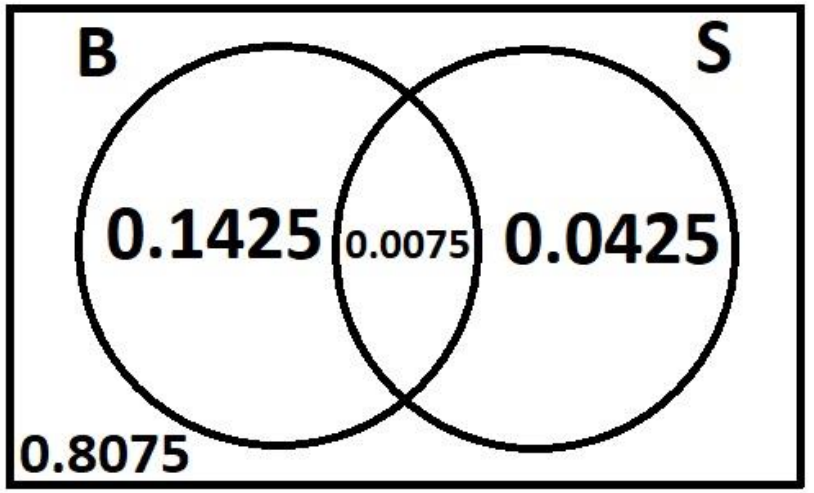
Q2. Fifteen per cent of a new sports car model have defective brakes and defective steering occurs 5% of the time in this model. Assume these problems occur independently. If one or other (but not both) of these problems are present the car is called a 'lemon'. If both problems are present the car is called a 'hazard'. Draw both a Venn diagram and a joint probability table. What is the probability that the car is:

a) a hazard

b) a lemon

(Poll)

	S	S'	Total
B	0.0075	0.1425	0.15
B'	0.0425	0.8075	0.85
Total	0.05	0.95	1

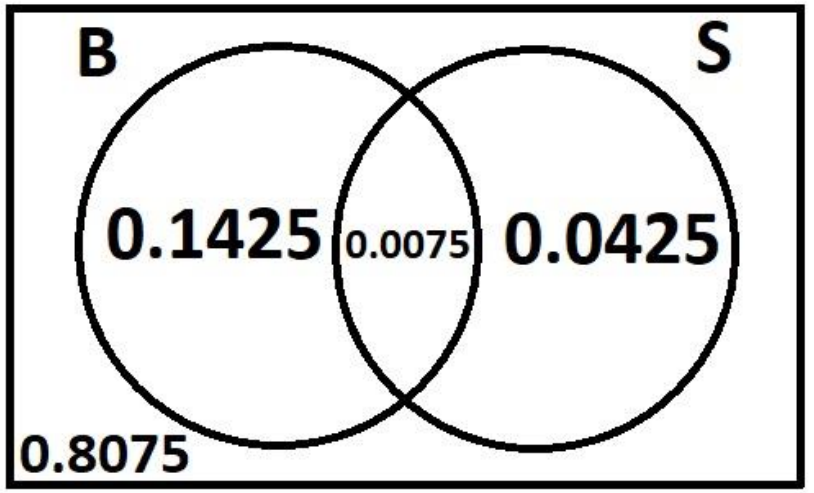


Q2. Fifteen per cent of a new sports car model have defective brakes and defective steering occurs 5% of the time in this model. Assume these problems occur independently. If one or other (but not both) of these problems are present the car is called a 'lemon'. If both problems are present the car is called a 'hazard'. Draw both a Venn diagram and a joint probability table. What is the probability that the car is:

a) a hazard — P(B and S) = P(B ∩ S) = P(B) * P(S) (independent)

b) a lemon — P(B or S) -> but not both
= P(B ∩ S') + P(B' ∩ S)
= P(B ∪ S) - P(B ∩ S)

	S	S'	Total
B	0.0075	0.1425	0.15
B'	0.0425	0.8075	0.85
Total	0.05	0.95	1



Q2. Fifteen per cent of a new sports car model have defective brakes and defective steering occurs 5% of the time in this model. Assume these problems occur independently. If one or other (but not both) of these problems are present the car is called a 'lemon'. If both problems are present the car is called a 'hazard'. Draw both a Venn diagram and a joint probability table. What is the probability that the car is:

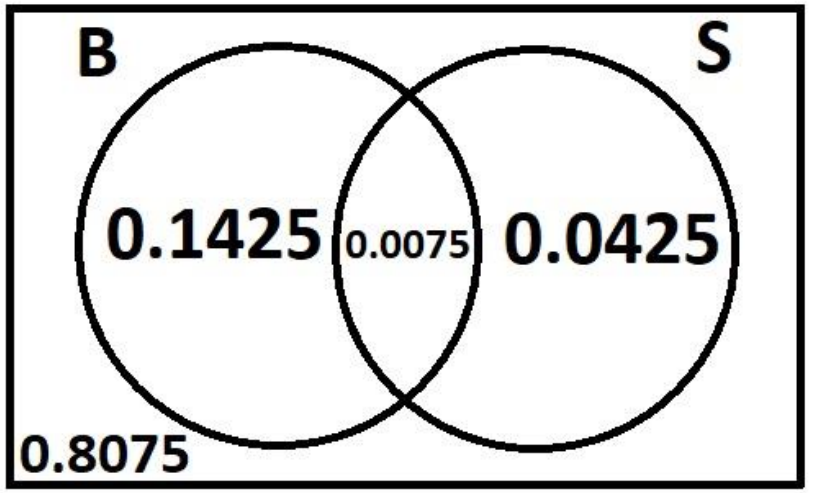
a) a hazard

P(B and S) = P(B ∩ S) = P(B) * P(S) = 0.15 * 0.05 = 0.0075

b) a lemon

P(B or S, but not both)
= P(B ∩ S') + P(B ∩ S') = 0.1425 + 0.0425 = 0.185
= P(B ∪ S) - P(B ∩ S)

	S	S'	Total
B	0.0075	0.1425	0.15
B'	0.0425	0.8075	0.85
Total	0.05	0.95	1



Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs.

b. Find the proportion of MBAs who are not managers.

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs.

b. Find the proportion of MBAs who are not managers.

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

$P(Mg) = 0.17$
$P(MBA) = 0.28$
$P(MBA \mid Mg) = 0.6$
$P(MBA \cap Mg) = ?$

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs.

b. Find the proportion of MBAs who are not managers.

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

P(Mg) = 0.17
P(MBA) = 0.28
P(MBA | Mg) = 0.6
P(MBA ∩ Mg) = P(MBA | Mg) * P(Mg) = 0.6 * 0.17 = 0.102

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs. 0.102

b. Find the proportion of MBAs who are not managers.

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

	MBA	MBA'	Total
Mg	0.102	0.068	0.17
Mg'	0.178	0.652	0.83
Total	0.28	0.72	1

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs. 0.102

b. Find the proportion of MBAs who are not managers.

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

P(Mg' | MBA) = ?

	MBA	MBA'	Total
Mg	0.102	0.068	0.17
Mg'	0.178	0.652	0.83
Total	0.28	0.72	1

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs. 0.102

b. Find the proportion of MBAs who are not managers.

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

$$P(Mg' \mid MBA) = \frac{P(Mg' \cap MBA)}{P(MBA)} = \frac{0.178}{0.28} = 0.6357$$

	MBA	MBA'	Total
Mg	0.102	0.068	0.17
Mg'	0.178	0.652	0.83
Total	0.28	0.72	1

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs. 0.102

b. Find the proportion of MBAs who are not managers. 0.6357

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer.

To be independent it is necessary: P(MBA | Mg) = P(MBA)

	MBA	MBA'	Total
Mg	0.102	0.068	0.17
Mg'	0.178	0.652	0.83
Total	0.28	0.72	1

Q3. Seventeen per cent of the employees in a company have managerial positions, and 28% of the employees have MBA degrees. Also, 60% of the managers have MBAs.

a. Find the proportion of employees who are managers and have MBAs. 0.102

b. Find the proportion of MBAs who are not managers. 0.6357

c. Are the events *being a manager* and *having an MBA* independent? Justify your answer. No

To be independent it is necessary: P(MBA | Mg) = P(MBA)
(0.6) (0.28)

	MBA	MBA'	Total
Mg	0.102	0.068	0.17
Mg'	0.178	0.652	0.83
Total	0.28	0.72	1

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

a. Find the probability the employee took the actual holiday given they were managerial level.

b. What is the probability that a marketing employee added the holiday to their vacation?

c. What is the probability that one of the clerical employees will take a random day holiday?

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

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e. Are the type of job and holiday independent? Explain.

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
K	0.1767	0.2600	0.0167	0.4533
Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
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P(H | M) = ?

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Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

$$P(H \mid M) = \frac{P(H \cap M)}{P(M)}$$

a. Find the probability the employee took the actual holiday given they were managerial level.

b. What is the probability that a marketing employee added the holiday to their vacation?

c. What is the probability that one of the clerical employees will take a random day holiday?

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

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Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

$$P(H \mid M) = \frac{P(H \cap M)}{P(M)} = \frac{0.0167}{0.2433} = 0.0685$$

b. What is the probability that a marketing employee added the holiday to their vacation?

c. What is the probability that one of the clerical employees will take a random day holiday?

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
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Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

P(V | K) = ?

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

b. What is the probability that a marketing employee added the holiday to their vacation?

c. What is the probability that one of the clerical employees will take a random day holiday?

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
K	0.1767	0.2600	0.0167	0.4533
Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

b. What is the probability that a marketing employee added the holiday to their vacation? 0.574

c. What is the probability that one of the clerical employees will take a random day holiday?

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

$$P(V \mid K) = \frac{P(V \cap K)}{P(K)} = \frac{0.26}{0.4533} = 0.574$$

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
K	0.1767	0.2600	0.0167	0.4533
Total	0.2367	0.4700	0.2933	1.0000

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b. What is the probability that a marketing employee added the holiday to their vacation? 0.574

c. What is the probability that one of the clerical employees will take a random day holiday?

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

$P(R \mid C) = ?$

$= \frac{P(V \cap K)}{P(K)}$

$= \frac{0.26}{0.4533} = 0.574$

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
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Clerical	13	46	32
marketing	53	78	5

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

b. What is the probability that a marketing employee added the holiday to their vacation? 0.574

c. What is the probability that one of the clerical employees will take a random day holiday? 0.352

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

$$P(R \mid C) = \frac{P(R \cap C)}{P(C)} = \frac{0.1067}{0.3033} = 0.352$$

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
K	0.1767	0.2600	0.0167	0.4533
Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

P((V ∪ R) | M) = ?

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

b. What is the probability that a marketing employee added the holiday to their vacation? 0.574

c. What is the probability that one of the clerical employees will take a random day holiday? 0.352

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e. Are the type of job and holiday independent? Explain.

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
K	0.1767	0.2600	0.0167	0.4533
Total	0.2367	0.4700	0.2933	1.0000

Q4. Consider the company that was interested in how employees used the two floating holidays that were part of their package. The data are shown in the contingency table.

Type of job	Took actual holiday	Added to vacation	Took random days
managerial	5	17	51
Clerical	13	46	32
marketing	53	78	5

$P((V \cup R) \mid M) = P(H' \mid M) = ?$

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

b. What is the probability that a marketing employee added the holiday to their vacation? 0.574

c. What is the probability that one of the clerical employees will take a random day holiday? 0.352

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day?

e. Are the type of job and holiday independent? Explain.

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e. Are the type of job and holiday independent? Explain.

$$P((V \cup R) \mid M) = P(H' \mid M) = \frac{P(H' \cap M)}{P(C)} = \frac{0.0567 + 0.17}{0.2433} = 0.9315$$

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M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
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marketing	53	78	5

To be independent:
P(M | H) = P(M)

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

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c. What is the probability that one of the clerical employees will take a random day holiday? 0.352

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e. Are the type of job and holiday independent? Explain.

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Type of job	Took actual holiday	Added to vacation	Took random days
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marketing	53	78	5

To be independent:

$P(M \mid H) = P(M)$

$\frac{P(M \cap H)}{P(H)} \neq 0.2433$

$\frac{0.0167}{0.2367} \neq 0.2433$

$0.0706 \neq 0.2433$

a. Find the probability the employee took the actual holiday given they were managerial level. 0.0685

b. What is the probability that a marketing employee added the holiday to their vacation? 0.574

c. What is the probability that one of the clerical employees will take a random day holiday? 0.352

d. What is the probability that a managerial employee added the holiday to their vacation or took a random day? 0.9315

e. Are the type of job and holiday independent? Explain. No

	H	V	R	Total
M	0.0167	0.0567	0.1700	0.2433
C	0.0433	0.1533	0.1067	0.3033
K	0.1767	0.2600	0.0167	0.4533
Total	0.2367	0.4700	0.2933	1.0000

ECON1310
Tutorial 3 – Week 4

PROBABILITY I

At the end of this tutorial you should be able to

- Define the basic concepts used in simple probability problems.
- Define the four types of probability.
- Use the addition and multiplication rules to calculate various probabilities.
- Construct a contingency table and calculate various probabilities.
- Construct a simple tree diagram and calculate various probabilities.
- Test the independence of events using a contingency table.

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

Thank you

Francisco Tavares Garcia

Academic Tutor | School of Economics

tavaresgarcia.github.io

Reference

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