1. Miss Amy teaches a kndergarten class of 12 kids, 7 of whom take the bus home after school. When the day ends, she has the children line up one behind the other in a a random order to take them to the appropriate exit.

   (a) (1 point) In how many possible ways can the 12 kids line up?

   (b) (3 points) What is the probability that **exactly** 2 of the students who take the bus end up in the front half of the line?

   (c) (3 points) What is the probability that the line specifically starts with three kids who take the bus home, followed by 2 kids who don't?

   (d) (3 points) Each of the 5 students student who does not take the bus is asked to place a drawing in the backpack of a classmate who takes the bus. The backpack is chosen at random and there is no rule stating that a student can't receive multiple drawings in their backpack. If Emily takes the bus, what is the probability that she receives no drawings in her backpack?

2. People are randomly picked off of the street to receive a prize! Each person gets to choose between $200 cash, a $400 gift certificate to a spa, or two tickets to a Habs game. Prizes could only be offred to adults and the results, broken down according to age, are as follows:

	Cash (C)	Spa Certificate (S)	Hab Tickets (H)	Total
Age 18-35 (X)	35	14	48	97
Age 36 and up (Y)	44	32	67	143
Total	79	46	115	240

   Suppose that one person is selected at random from this group.

   (a) (2 points) Find the Probability that a randomly selected person chose cash if the are in the 18-35 age group.

   (b) (2 points) Find the probability that a randomly selected person was from the age group "36 and up" or did not choose Habs tickets.

   (c) (2 points) Are the events X and H independent? Justify your answer mathematically.

   (d) (2 points) Using this data, give an example of two events that are mutually exclusive and justify.

3. Nellie's Baking Boutique is frequently commissioned to bake custom celebration cakes. 54% of those cakes contain chocolate, 22% contain fruit, and 35% contain neither.

   (a) (2 points) What percentage of items at the bake sale contain both chocolate AND fruit?

   (b) (2 points) In a random sample of 8 custom celebration cakes Nellie's Baking Boutique is commissioned to create, what is the probability that exactly 7 will contain chocolate?

   (c) (4 points) In a random sample of 8 custom celebration cakes Nellie's Baking Boutique is commissioned to create, what is the probability that at least 2 will NOT contain chocolate?

4. An insurance company keeps a record of the number of at-fault claims that clients will make with their car insurance, as well as the associated probabilities. After 5 at-fault claims, insurance coverage geets cancelled, so you may assume that all possibilities are listed in the table below.

Number of at-fault claims (x)	0	1	2	3	4	5
Probability $(P(x))$	0.46	0.37	?	0.05	0.008	0.002

(a) (1 point) Find the missing probability.

(b) (1 point) What is the probability of someone having more than one at-fault claim on their record?

(c) (2 points) Calculate the expected number of at–fault claims.

(d) (3 points) Calculate the standard deviation of this random variable.

5. A major city is home to two universities: Cardenia and MacDougall. A recent survey shows that at Cardenia, 5% of students have a full-time job, 62% of students have a part-time job, and the rest do not have a job at all. In contrast, at MacDougall, only 1% of students have a full-time job, 46% have a part-time job, and the rest don't have a job. All university students in the city attend either Cardenia or MacDougall, and 55% attend Cardenia.

(a) (3 points) Find the percentage of students in this city who work part-time.

(b) (4 points) If Heather is a university student in the city in question, and she does not have a job, what is the probability that she attends MacDougall?

6. A simple random sample of 30 children's picture books revealed that 18 of them end with someone falling asleep.

(a) (1 point) If we select a book at random from this sample of 30, what is the probability that it will end with someone falling asleep?

(b) (3 points) Give the 92% confidence interval for the true proportion p of children's books that end with someone falling asleep.

(c) (3 points) If we use the answer from part (a) as an initial approximation for the true proportion p of all children's picture books that end with someone falling asleep, how many books need to be included in the sample in order to estimate p within 4% of the true proportion at a 92% confidence level?

7. In New York City, a large number of buskers (street musicians) try to make some cash playing in the subways and in commercial areas. A recent study shows that these performers collect totals that are normally distributed with an average of $125 per day with a population standard deviation of $40.

(a) (4 points) Suppose a random busker is asked to tally up their earnings for a day of performing. What is the probability that they will have made between $100 and $130?

(b) (3 points) The data indicates that Charlene's pop violin performance brought in more than 84% of the NYC buskers today. How much has Charlene made with her performance today?

(c) (4 points) If we randomly selected 9 of today's active NYC buskers, what is the probability that the mean amount they've earned today is greater than $132 (the equivalent of a full day's work at minimum wage)?

8. Market research indicates that 70% of Americans watch the Superbowl every year. Let r represent the number of Americans who watch the Superbowl from a randomly selected group of 25 Americans.

(a) (1 point) What is the expected value of r?

(b) (1 point) What is the standard deviation of r?

(c) (4 points) Use a normal approximation to find the probability that at most 19 Americans from the group will watch the Superbowl this year.

9. (3 points) We wish to estimate the true proportion p of all people who will initially refuse to try antidepressants when they are first suggested by their doctor or therapist. What is the minimum sample size needed if we wish to obtain an estimate within 4% of the true proportion when operating at a 94% confidence level?

10. A survey of CEGEP students seeks to determine the average amount of money a CEGEP student earns annually. A sample of 100 randomly selected CEGEP students yielded a mean of $4320.

(a) (3 points) Assuming that student earnings are normally distributed with a population standard deviation of $1050, give an 80% confidence interval for the true population mean amount of money CEGEP students earn annually. Round your answers to the nearesr cent.

(b) (3 points) How many <u>more</u> students would have to be surveyed if we wish to obtain an estimate that is within $50 of the true population mean? (Assume that we are still operating with an 80% confidence level.)

11. A new therapeutic approach is being examined to address people who suffer a trauma substantial enough to cause them to stop working. With this new treatment, the time patients take to return to work is known to be normally distributed with a true standard deviation of 9 weeks. Bianca received this new treatment and felt sufficiently prepared to return to work after 24 weeks. If a random sample of 16 people receiving the treatment in question after their trauma returned to work after an average of 26 weeks, test the theory that Bianca's return to work was faster than the true population mean. Use an $\alpha = 0.08$ level of significance.

(a) (2 points) State the null and alternative hypotheses.

(b) (2 points) Calculate the test statistic.

(c) (3 points) Find (or estimate) the p-value for the test.

(d) (2 points) State and **interpret** your conclusion.

12. An investigation is launched to verify whether or not the number of women interested in persuing Bachelor's degrees in Software Engineering in Canada is changing. Do accomplish this, enrollment numbers from six Canadian Universities with a Software Engineering program checked and the number of female students are noted both in 2000 and in 2025. The results are below:

University	1	2	3	4	5	6
Female Enrollment In 2000	67	14	76	31	57	37
Female Enrollment In 2025	82	13	88	36	51	51

Suppose that female enrollment numbers in Software Engineering are normally distributed across Canadian Universities. Use a 5% significance level to test the hypothesis that the number of women enrolling in Software Engineering programs is different in 2025 than it was in 2000.

(a) (2 points) State the null and alternative hypotheses.

   (b) (1 point) If the mean increase in female emrolment across our sample of six universities is 6.5, calculate the sample standard deviation of that inrease in enrolment.

   (c) (2 points) Calculate the test statistic.

   (d) (3 points) Find (or estimate) the p-value for the test.

   (e) (2 points) State and **interpret** your conclusion.

13. Two surveys were conducted that asked CEGEP students to approximate how many books they own (not counting books for school). One survey was anonymous, whereas the other was conducted non-anonymously. The anonymous survey included 71 individuals and yielded a mean of 89.7 books and a sample standard deviation of 31.2. The non-anonymous survey included 51 individuals and yielded a mean of 102.3 and a sample standard deviation of 37.9.

   (a) (3 points) Find a 75% confidence interval for the true average difference between the anonymous and non-anonymous survey.

   (b) (2 points) To check for a social desirability bias, it is of interest to verify if there is sufficient evidence of a true difference in means between the anonymous and non-anonymous surveys. Complete the sentence below, based on the hypotheses $H_0 : \mu_1 - \mu_2 = 0$ and $H_a : \mu_1 - \mu_2 \neq 0$.

    The answer in part (a) indicates that we should _____ (write *accept, reject,* or *fail to reject*) **the null hypothesis at the** _____ (enter a number) **significance level.**

14. Complete the following sentences with the words **greater** or **smaller**, as appropriate. Each word may appear once, more that once, or not at all.

   (a) (1 point) The width of a 90% confidence interval is _____ when we know the population standard deviation than when we know only the sample standard deviation.

   (b) (1 point) A null hypothesis $H_0 : \mu = 0$ has a _____ probability of being rejected if we increase the significance level α.

   (c) (1 point) The value of $P_{n,r}$ is never _____ than the value of $C_{n,r}$.

ANSWERS

1. (a) 479 001 600

   (b) $\dfrac{C_{6,2} \cdot C_{6,5}}{\text{total possible positions of bus takers}} = 0.1136$

   (c) 0.0442

   (d) 0.4627

2. (a) 0.3608

   (b) 0.8

   (c) No. $P(X|H) \neq P(X)$ or $P(H|X) \neq P(H)$

   (d) Many answers possible.

3. (a) 11%

   (b) 0.0493

   (c) 0.9435

4. (a) 0.11

   (b) 0.17

   (c) 0.782

   (d) 0.9091

5. (a) 54.8%

   (b) 0.5679

6. (a) 0.6

   (b) [0.4435, 0.7565]

   (c) 460

7. (a) 0.2874

   (b) $164.60

   (c) 0.2981

8. (a) 17.5

   (b) 2.2913

   (c) 0.8078

9. 553

10. (a) [4185.60, 4454.40]

    (b) 623

11. (a) $H_0 : \mu = 24;\ H_a : \mu > 24$

    (b) $z^* \approx 0.89$

    (c) P-value $= 0.1867$

    (d) Fail to Reject H_0 (There is insufficient evidence to claim that Bianca's return to work was faster than the true population average.)

12. (a) $H_0 : \mu_d = 0;\ H_a : \mu_d \neq 0$

    (b) $s_d = 8.6429$

    (c) $t^* \approx 1.842$

    (d) $0.100 < P$-value < 0.150

    (e) Fail to Reject H_0 (There is insufficient evidence to claim that number of women enrolling in Software Engineering is different in 2025 than it was in 2020..

13. (a) $[-20.1324, -5.0676]$

    (b) REJECT, 0.25

14. (a) SMALLER

    (b) GREATER

    (c) SMALLER