Curtin University, Semester 2, 2026

# ECOM5005 Tutorial 7A

*The Normal Distribution and Other Continuous Distributions*

**Preparation expectation.** Remember that you are expected to prepare for the tutorial prior to your tutorial. Attempt each problem before class and bring specific questions about any step you cannot complete.

## Learning Outcomes

1. Use the normal distribution and Z-scores to calculate probabilities and percentiles.
2. Evaluate whether a continuous variable is reasonably approximated by a normal distribution.
3. Calculate probabilities, means and standard deviations for continuous uniform distributions.
4. Use the exponential distribution to model waiting times between random events.
5. Apply the normal approximation to a binomial distribution using a continuity correction.
6. Use Excel to analyse a real-world continuous dataset and interpret tables and graphs.

## PART 1 - Applied tutorial problems

### Question 1 - Grocery-delivery service levels (Normal distribution)

A same-day grocery platform models delivery time X as normally distributed with mean 42 minutes and standard deviation 8 minutes.
(a) Find $P(X < 35)$.
(b) Find $P(35 < X < 55)$.
(c) Find the delivery-time threshold that 90% of orders are expected to meet.
(d) If 200 deliveries are made in one evening, approximately how many would you expect to take more than 60 minutes? Interpret the result for operations management.

### Question 2 - Warehouse robot cycle times (Evaluating normality)

A distribution centre records 240 autonomous-robot cycle times (seconds). The summary is: mean = 63.8, median = 60.1, standard deviation = 15.0, IQR = 16.2, range = 108, skewness = 1.35, kurtosis = 2.90. In addition, 74% of observations lie within mean ±1σ, 88% within mean ±1.28σ, and 96% within mean ±2σ. The normal probability plot bends upward in the upper tail.
(a) Compare each diagnostic with the normal-distribution benchmarks from the lecture.
(b) Decide whether a normal model is appropriate and explain why.
(c) If a manager nevertheless uses $N(63.8,15^2)$, estimate $P(X > 90)$ and explain why this model-based probability should be treated cautiously.

### Question 3 - Rideshare pickup promise (Uniform distribution)

During a controlled airport trial, a rideshare company assumes passenger pickup time X is uniformly distributed between 4 and 12 minutes.
(a) Find $P(X < 6)$.
(b) Find $P(7.5 < X < 10)$.
(c) Calculate the mean and standard deviation of pickup time.
(d) The company gives a $5 credit whenever pickup time exceeds 10 minutes. For 500 rides, how many credits are expected, and what is the expected total cost?

### Question 4 - Cybersecurity incident arrivals (Exponential distribution)

A security operations centre receives high-priority alerts at an average rate of 3 per hour. Assume the waiting time X between alerts follows an exponential distribution with rate $\lambda = 3$ per hour.
(a) Find the probability that the next alert arrives within 10 minutes.
(b) Find the probability that the waiting time exceeds 30 minutes.
(c) Find t such that there is a 90% probability the next alert arrives within t minutes. Interpret t as an operational planning threshold.

### Question 5 - Online-order returns (Normal approximation to binomial)

An online retailer historically receives returns on 8% of orders. On a promotional weekend, n = 600 orders are shipped. Let X be the number eventually returned.
(a) Check whether the normal approximation to the binomial is appropriate, and calculate the approximating normal mean and standard deviation.
(b) Using a continuity correction, approximate $P(X \geq 60)$.
(c) Using a continuity correction, approximate $P(40 \leq X \leq 55)$.
(d) Explain in words what the continuity correction is doing.

# PART 2 - Data exercise: Palmer Penguins

Download and open the accompanying Excel file "Palmer_Penguins_Data.xlsx". The workbook contains a curated teaching subset of 100 Adelie penguin records from the Palmer Penguins dataset. The original measurements were collected through the Palmer Station, Antarctica Long Term Ecological Research program. One record contains missing numeric measurements; Excel functions such as AVERAGE and STDEV.S will ignore blank cells.

*Data source: https://github.com/allisonhorst/palmerpenguins/blob/main/inst/extdata/penguins.csv*

Complete all analysis in Excel. Your main variable for normality assessment is Bill Length (mm), located in Penguin_Data!C6:C105.

(a) Produce a descriptive-statistics table for Bill Length, Bill Depth, Flipper Length and Body Mass. Include count, mean, median, mode, standard deviation, variance, minimum, Q1, Q3, maximum, range, skewness and kurtosis.
(b) Create a histogram for Bill Length. Describe its centre, spread, symmetry and any unusually short or long bills.
(c) For Bill Length, compare the IQR with 1.33 × standard deviation and compare the range with 6 × standard deviation. What do these checks suggest about normality?
(d) Calculate the percentage of Bill Length observations lying within mean ±1 standard deviation, mean ±1.28 standard deviations, and mean ±2 standard deviations. Compare your percentages with the normal benchmarks 68.26%, 80% and 95.44%.
(e) Construct a normal probability (Q-Q) plot for Bill Length using ordered observations and theoretical Z quantiles. Add a linear trendline and display $R^2$. Does the plot look approximately linear?
(f) Fit a normal model using the sample mean and sample standard deviation of Bill Length. Use Excel to estimate $P(X < 36)$, $P(37 \leq X \leq 41)$, and $P(X > 44)$. Then calculate the corresponding empirical proportions from the data and compare.
(g) Calculate a Z-score for every non-missing Bill Length observation. Identify any observations with $|Z| > 2$ and explain whether they should automatically be deleted.

# PART 3 - Pearson MyLab

1. Complete **Quiz #3** on MyLab which has been released on **Tuesday (15-Sep-2026)** and will be **due** by **next Tuesday (22-Sep-2026)** at **5:00pm AWST**.

**Note:** If you are having issues with obtaining access to MyLab, please re-read the instructions (available in the welcome topic). If you are still unsuccessful, please send an email to the teaching team explaining the issue. It is important that you complete MyLab tasks on a weekly basis since the final e-test in this unit will be completed using MyLab.