ISE 2211 Test 5 (Normal Distribution) Course Notes and Course Activities

Course Notes:

Use Standard Normal Distribution Table or Excel Normal Distribution Functions (see below) to determine:

$P(Z_a < Z < Z_b)$
z given the probability of $P(Z < z)$ = probability p
z given the probability of $P(Z > z)$ = probability p

Given: Normal Distribution with Mean μ, Standard Deviation σ

Apply Z-Score, using the $Z = \frac{X - \mu}{\sigma}$ equation as appropriate.

Find: $P(a < X < b)$
Find: x given $P(X < x)$ = probability p
Find: x given $P(X > x)$ = probability p

Solve engineering problems using the above techniques.
Answer concept questions related to Normal Probability Distributions.

Course Activities:

The following activities will preferably be completed using the MS Excel formulas/functions: or a similar electronic spreadsheet.

STANDARDIZE, Z.TEST, NORM.DIST, NORM.INV, NORM.S.DIST, MORM.S.INV

References:

Standard Normal Distribution Table (Z Table)
http://www.stat.ufl.edu/~athienit/Tables/Ztable.pdf

Excel Normal Distribution Functions

Z - Score
STANDARDIZE(X, μ, σ)
Given a Normal Distribution with Mean μ, Standard Deviation σ, and some value X; Find $Z = \frac{X-\mu}{\sigma}$
Example: Normal Distribution Mean u = 125, Standard Deviation σ = 15, X = 150
=STANDARDIZE(150, 125, 15) = 1.67

Standard Normal Z Distribution (Mean u = 0 and Standard Deviation σ = 1)
NORM.S.DIST(Z, True/False)
Find P(Z < z), given z.
Example: z = 1.50
=NORM.S.DIST(1.50) = 0.9332

Normal Distribution
NORM.DIST(X, μ, σ, True/False)

If *True*, returns Cumulative Distribution Function P(X); i.e., integral from negative infinity to x.
Example: u = 125, σ = 15, X = 150, True
= NORM.DIST(150, 125, 15, True) = 0.9521
Note: This is the same as P(Z) = P($Z = \frac{X-\mu}{\sigma}$) = P([150 - 125] / 15) = P(1.667) = 0.9522
Note: If μ = 0 and σ = 1, this is the same as the Standard Normal Z Distribution see above NORM.S.DIST

If *False*, returns the probability mass function $$f(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\left(\frac{(x-\mu)^2}{2\sigma^2}\right)}$$
Example: u = 125, σ = 15, X = 150, False
=NORM.DIST(150, 125, 15, False) = 0.0066 Note: We will not use this function.

Z Inverse (Standard Normal Distribution)
NORM.S.INV(probability)
Find z, given P(Z < z) = probability p.
Example: P(Z < z) = 0.9522
=NORM.S.INV(0.9522) = 1.667
Example: P(Z < z) = 0.0808
=NORM.S.INV(0.0808) = -1.40

Z Inverse (Normal Distribution)
NORM.INV(probability, μ, σ)
Given a Normal Distribution with Mean μ, Standard Deviation σ, and probability p.
where $Z = \frac{X-\mu}{\sigma}$, Find X such that P(X < x) = p
Example: p = 0.8413 μ = 100 σ = 25
=NORM.INV(0.8413, 100, 25) = 125   Note: Z = 1.00 from Table
Example: p = 0.1131 μ = 100 σ = 25
=NORM.INV(0.1131, 100, 25) = 69.8   Note: Z = -1.21 from Table

Note:
P(a < X < b) = P(X < b) - P(X < a)
P(Z > z) = 1 - P(Z < z)

Be aware there will be some small rounding errors.