

- ▶ Unit 1: Introduction to Probability
- ▶ **Unit 2: Probability Distributions**
- ▶ Unit 3: Statistical Inference
- ▶ Unit 4: Introduction to Linear Regression
- ▶ Unit 5: Regression Analysis
- ▶ Unit 6: Regression Modeling

Announcements

► Past:

Unit 1 Individual Assignment solutions available and scores posted.

► Present:

Unit 2 Individual Assignment **due Monday, 23:59 ET** (Durham local time).

► Future:

Unit 3 materials and team assignment available.

► Normal Distribution

- Only need to determine “how many standard deviations from the mean” to calculate probabilities.
- The 1-2-3 rule for probabilities under normal distribution (68% - 95% - 99.7%).



► Sampling Distributions

- The Sample Mean \bar{X} is a random variable which estimates the mean of an unknown population.
- The Sample Variance S^2 is a random variable which estimates the variance of an unknown population.
- The distribution of \bar{X} (and of S^2) does not depend on the underlying population distribution (for large enough sample size n).

► The Central Limit Theorem

- The Sample Mean \bar{X} approaches a normally distributed random variable, regardless of the distribution of X .
- The expected value of the sample mean: $\mathbb{E}[\bar{X}] = \mathbb{E}[X]$. (No bias.)
- The standard deviation of the Sample Mean (a.k.a. the Standard Error of the Sample Mean):

$SE = \sqrt{\text{Var}[\bar{X}]} = \sqrt{\text{Var}[X]}/\sqrt{n}$. (SE, a.k.a. standard deviation of the Sample Mean is reduced by a factor of \sqrt{n} relative to the standard deviation of any single observation in the sample.)

Managing demand uncertainty for a new product

The monthly sales demand for a new product is uncertain, but it is considered to be adequately described by a normal random variable with mean 50,000 units and variance 100,000,000.

- a) What is the standard deviation of the demand?
- b) What is the probability that the demand will be between 30,000 and 60,000 units?
- c) The accounting department has indicated that there is a 10% chance that the new product will not generate enough monthly sales volume to make a profit. What is the break-even sales level per month?

Managing demand uncertainty for a new product

The monthly sales demand for a new product is uncertain, but it is considered to be adequately described by a normal random variable with mean 50,000 units and variance 100,000,000. (units)²

a) What is the standard deviation of the demand?

$$\text{STD. DEV} = \sqrt{\text{VARIANCE}} = \sqrt{100,000,000} = 10,000$$

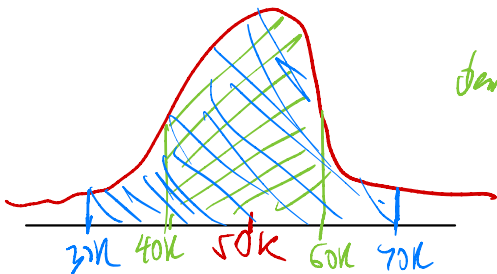
$X = \text{demand}$

normal

$$X \sim N(50000, 100,000,000)$$

$N(\underbrace{50000}_{\text{mean}}, (\underbrace{10,000}_{\text{STD. DEV}})^2)$

is distributed as



Managing demand uncertainty for a new product

The monthly sales demand for a new product is uncertain, but it is considered to be adequately described by a normal random variable with mean 50,000 units and variance 100,000,000.

b) What is the probability that the demand will be between 30,000 and 60,000 units?

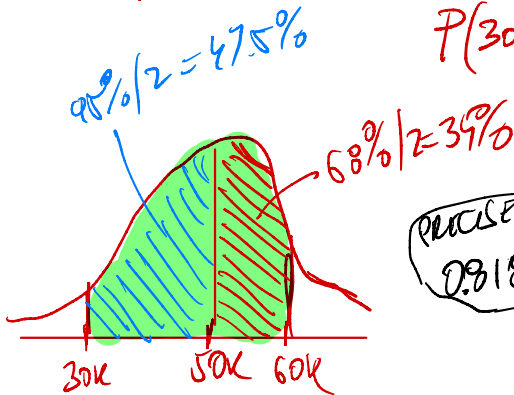
$X = \text{demand}$

$$X \sim N(50000, (10000)^2)$$

$$P(30000 < X < 60000) =$$

$$= .475 + .34$$

$$= .815$$



PRECISE CALC
0.81859

$$N(\mu, \sigma^2)$$
$$P(N \leq x) = \text{NORM.DIST}(x, \mu, \sigma, \text{TRUE})$$

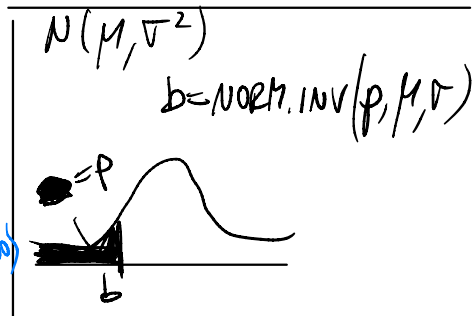
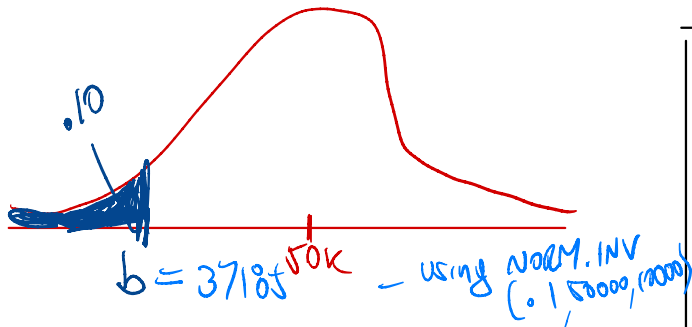


Managing demand uncertainty for a new product

The monthly sales demand for a new product is uncertain, but it is considered to be adequately described by a normal random variable with mean 50,000 units and variance 100,000,000.

- c) The accounting department has indicated that there is a 10% chance that the new product will not generate enough monthly sales volume to make a profit. What is the break-even sales level per month?

$$X = \text{demand} \quad X \sim N(50000, (10000)^2)$$



Production process calibration

A manufacturer of a generic drug produces caplets which contain 250mg of the medication substance. The production process includes a natural slight variability in the exact contents of each caplet, so the company set a mean weight target at 255mg per caplet. (This allowable 2% increase in the target mean ensures sufficient medication in each caplet, without risking overdosage.)

A sample of 150 caplets is selected from the output of the caplet production process. Each caplet is carefully inspected for its medication content, which is recorded in the data file `CapletWeights_Data`.

Based on this data, what is the estimate for the mean and standard deviation of the medication content for manufactured caplets?

What do you think about the accuracy of how the mean weight target is currently set?

Unit 2 Individual Assignment

- ▶ Due Monday, 23:59 ET (Durham local time).
- ▶ Six questions: includes multiple choice, numeric response, multiple answers formats.
- ▶ No need to show your work, i.e., no supporting documents needed.

Assignment questions:

- ▶ Questions 1-3: normal distribution.
- ▶ Question 4: conceptual.
- ▶ Questions 5-6: use sample data to compute sample statistics .