MTH 23.5 LECTURE NOTES (Ojakian)

Topic 19: Normal Distributions

OUTLINE

References (**Algebra Book**: None; **Statistics Book**: 5.1, 5.2, 6.1, 6.2)

1. Normal Distribution
2. Inverse Normal Distribution

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1. Basic Shape of Normal Distribution

   Definition: A normal curve is a graph that looks like this ... [ok, I'll draw it!]

   Also called Bell Curve. Who discovered it??

   PROBLEM 1. *Which of the distributions on the sheet Normal Curves 1 are approximately normal?*

   Why of interest? Many natural phenomenon have a distribution that is close to normal.

2. Normal Curve as Continuous Distribution

   (a) To specify a normal distribution need 2 values: Mean and Standard Deviation.

      i. The peak is at the mean.
      ii. Standard deviation indicates how spread out the distribution is.
      iii. One Standard Deviations - at inflection points

   (b)

   PROBLEM 2. *Consider the normal distributions on the sheet Normal Curves 2. What are the means? Order the distributions by standard deviation by general spread. Then label the points that are one standard deviation from the mean.*

   (c) PUT- Standard Normal Distribution (mean 0, SD = 1)

3. Working with Continuous Probability Distributions

   (a)

   PROBLEM 3. *Consider the continuous probability distributions on the sheet Normal Curves 3. For each distribution, find the probability of being in the range corresponding to each shaded region.*

   (b) Find other probabilities using app: http://www.intmath.com/counting-probability/normal-distribution-graph-interactive.php

Use the above app in the following problems

PROBLEM 4. *This is made up data! Consider the number of hours a person spends cooking in a week. Suppose it is normally distributed with mean 2.5 and standard deviation 0.7. Determine the following probabilities:*

i. What is the probability that a randomly chosen person spends between the heights of 1 and 3 hours cooking?

ii. What is the probability that a randomly chosen person spends less than 2 hours cooking?

iii. What is the probability that a randomly chosen person spends more than 2 hours cooking?

iv. What is the probability that a randomly chosen person spends more than 2.5 hours cooking? (how can you do this without the app?)

4. Special Properties of Normal Distributions

(a) The Empircal Rule:

i. Within ONE standard deviation: Area is 0.68

ii. Within TWO standard deviations: Area is 0.95

iii. Within THREE standard deviations: Area is 0.997

(b)

PROBLEM 5. *Apply the empirical rule to the above cooking scenario. Do problems using the empirical rule and using the app.*

PROBLEM 6. *Consider the normal distributions on the sheet Normal Curves 4. For each distribution, find the probability of being in the range corresponding to each shaded region.*

5. Using Excel

(a) `Norm.dist`(x-value, mean, standard deviation, true)

(b) Do some of above with Excel.

6. Inverse Normal

Normal distribution function goes from probability to x value.

The Inverse goes from an x to a probability.

(a) Openning example

PROBLEM 7. *Consider a normal distribution with a mean of 5 and standard deviation of 2. Use the online application, and then use the empircal rule.*

i. Find the x value, such that 0.5 of the area is to left of this x.

ii. Find the x value such that 2.5% of the data is to the left (use empircal rule).

iii. Find the x value such that 2.5% of the data is to the right (use empiral rule).

(b) Excel: `Norm.inv`(probability, mean, standard deviation)

PROBLEM 8. *For the following use the online application for both. Then use the empircal rule if you can; otherwise use Excel.*

i. Consider Problem 4 above. Suppose that probability that someone spends less than H hours cooking is 25%. What is H?

ii. Consider Problem 5 above. Suppose the probability someone cooks less than H hours is 16%. What is H?

7. Some Exercises

For problems, use combinations of 1) Logical reasoning using Empirical Rule, 2) The computer application, and 3) Excel

PROBLEM 9.

- *From the 5th Edition, section 7.3 do some of the problems from 5 to 14.*
- *From the 5th Edition, section 7.3 do some of the problems from 15 to 24 (include some non-standard).*

Some more inverse problems

PROBLEM 10. *From our class data, pick a type of data, and find the mean and standard deviation for our class. Assume the data for all BCC students is normally distributed with the same mean and standard deviation.*

(a) Compute some probabilities.

(b) Compute some inverse probabilities.

PROBLEM 11. *From 5th edition, section 7.1 do problem 8. Then use Excel to do the following:*

(a) What is the probability that an egg is hatched between 19.2 days and 24.6 days?

(b) After how many days are 50% *of the eggs hatched?*

(c) After how many days are 90% *of the eggs hatched?*

(d) For what range of days do we have that at least 15% *of the eggs are hatched, and no more than* 90% *of the eggs are hatched?*