MTH 23.5 LECTURE NOTES (Ojakian)

Topic 13: Binomial Distribution and Background

OUTLINE

References (**Algebra Book**: None; **Statistics Book**: 4.3)

1. Binomial Distributions

---

1. Calculation Background
   (a) Exponents
   (b) Factorial
   (c) $C_{n,r} = \dfrac{n!}{r! \cdot (n-r)!}$ = number of subsets of S of size r (S is any set with n elements).
   (d)

   PROBLEM 1. *Calculate the following:*

   i. $(0.4)^3$
   ii. $3!$
   iii. $1!$
   iv. $0!$
   v. $5 \cdot (10-8)!$
   vi. $C_{3,2}$
   vii. $(0.1)^4$
   viii. $4!$
   ix. $C_{4,1}$

2. Binomial Distribution
   (a) Binomial Experiment Example
      i. Flip the same coin 3 times and count the number of heads (biased so probability of heads is 0.2). What is the probability of all heads? What is the probability of 2 heads? Etc? Draw a probability tree diagram. Draw a histogram of the distribution.
      ii. Parameters/Terminology
      n = number of trails
      p = probability of "success"
      q = probability of "failure"
      r = number of successes
      $P(r)$ = probability of r successes
      $P(r < x)$ = probabillity of less than x successes (ETC.)
      iii. Using Excel
         A. BINOM.DIST(r, n, p,FALSE): For probability of **exactly r successes**.
         B. BINOM.DIST(r, n, p,TRUE): For probability of **r or fewer successes**.

         PROBLEM 2. *Use Excel to verify the above calculations.*

iv.

PROBLEM 3. *Use Excel for this question. From Section 6.2 (5th edition), do problem 14. Also answer these questions:*

A. *What is the probability that* **exactly** *3/4 of the men are wearing their ties too tight?*

B. *What is the probability that* **at least** *3/4 of the men are wearing their ties too tight?*

(b) Key formula

$P(r \text{ successes }) = C_{n,r}p^r q^{n-r}$

Along with the rest of probability theory! (complements, multiplication rule, addition rule, etc)

PROBLEM 4. *Use the formula to calculate some of the above probabilities by hand.*

PROBLEM 5. *From Section 6.2, do problem 15. Do it by hand, and using Excel.*

(c) Expectation of binomial distribution

Expectation $= np$

PROBLEM 6. *Steve Nash has the highest career foul shooting percentage of* 90.4% *(stats based on the last time I checked ...).*

i. *If he shoots 100 foul shots, how many do we expect to go in?*

ii. *If he shoots 25 foul shots, how many do we expect to go in?*

iii. *Do a simulation of 25 foul shots in Excel using RAND, to see how many go in. How close is the simulation to the expected value?*

(d) Standard Deviation, $\sigma = \sqrt{npq}$