Chapter 5
Discrete Probability Distributions

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The Binomial Probability Distribution

✓ Properties of a Binomial Experiment

- The experiment consists of a sequence of *n* identical trials.
- Two outcomes, ___________ and___________, are possible on each trial.
- The probability of a success, denoted by *p*, does not change from trial to trial.
- The trials are___________________.

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Example: Blue Print Engines

✓ Binomial Probability Distribution

Blue Print Engines of Kearney is concerned about a low retention rate for employees. On the basis of past experience, management has seen a turnover of 10% of the hourly employees annually. Thus, for any hourly employees chosen at random, management estimates a probability of 0.1 that the person will not be with the company next year.

Choosing 3 hourly employees at random, what is the probability that exactly 1 of them will leave the company this year?

Let: $p = .10$, $n = 3$, $x = 1$

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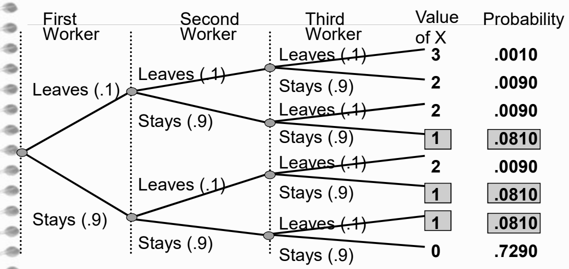
Example: Blue Print Engines



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The Binomial Probability Distribution

✓ Binomial Probability Function

$$f(x|n, p) = {}_nc_x \cdot p^x (1-p)^{(n-x)}$$

Where

x = the number of x successes in n trials

n = the number of trials

p = the probability of success on any one trial

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Example: Blue Print Engines

✓ Using the Binomial Probability Function

$$f(x|n, p) = {}_nc_x \cdot p^x (1-p)^{(n-x)}$$

$$f(x = 1|n = 3, p = .1) =$$

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Using the Tables of Binomial Probabilities

n	x	.10	.15	.20	.25	.30	.35	.40	.45	.50
		p								
3	0	.7290	.6141	.5120	.4219	.3430	.2746	.2160	.1664	.1250
	1	.2430	.3251	.3840	.4219	.4410	.4436	.4320	.4084	.3750
	2	.0270	.0574	.0960	.1406	.1890	.2389	.2880	.3341	.3750
	3	.0010	.0034	.0080	.0156	.0270	.0429	.0640	.0911	.1250

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Using the Tables of Binomial Probabilities

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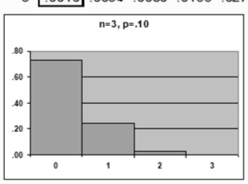

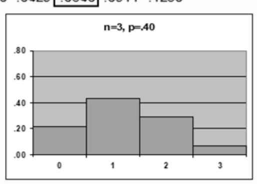

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Expected Value

$$E(x) = \sum x_i \cdot f(x_i)$$

n	x	f(x)	x_i f(x_i)
3	0	.7290	0.000
	1	.2430	0.243
	2	.0270	0.054
	3	.0010	0.003
			0.300

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The Binomial Probability Distribution

- ✓ Expected Value
  $E(x) = \mu = np$
- ✓ Variance
  $\sigma^2 = np(1 - p)$
- ✓ Standard Deviation
  $\sigma = \sqrt{np(1-p)}$

✓Example:

$E(x) = 3(.1) = .3$

$\sigma^2 = 3(.1)(.9) = .27$

$\sigma = .5196$

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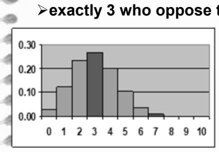
Low-level Nuclear Example

A UNK research has determined that 30% of the voters of Boyd County oppose the location of the Low Level Nuclear Waste Facility. What is the probability of randomly calling 10 voters in Boyd County and finding

➢**exactly 3 who oppose the location?**

$f(X = 3 | n = 10, p = .30) =$



n	x	P .30
10	0	.0282
	1	.1211
	2	.2335
	3	.2668
	4	.2001
	5	.1029
	6	.0368
	7	.0090
	8	.0014
	9	.0001
	10	.0000

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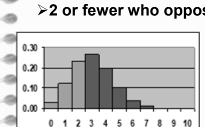
Low-level Nuclear Example

A UNK research has determined that 30% of the voters of Boyd County oppose the location of the Low Level Nuclear Waste Facility. What is the probability of randomly calling 10 voters in Boyd County and finding

➢**2 or fewer who oppose the location?**

$f(X \le 2 | n = 10, p = .30) =$



n	x	P .30
10	0	.0282
	1	.1211
	2	.2335
	3	.2668
	4	.2001
	5	.1029
	6	.0368
	7	.0090
	8	.0014
	9	.0001
	10	.0000

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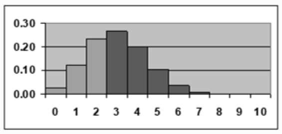
Using the Complementary Rule

n	x	P .30
10	0	.0282
	1	.1211
	2	.2335
	3	.2668
	4	.2001
	5	.1029
	6	.0368
	7	.0090
	8	.0014
	9	.0001
	10	.0000

$$f(x \geq 3 | n=10, p=.30)$$
$$=1-f(x<3 | n=10, p=.30)$$
$$=1-f(x \leq 2 | n=10, p=.30)$$



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Low-level Nuclear Example

A UNK research has determined that 70% of the voters of Boyd County do not oppose the location of the Low Level Nuclear Waste Facility.

What is the probability of randomly calling 10 voters in Boyd County and finding

- **exactly 7 who do not oppose the location?**
- **7 or more who do not oppose the location?**

n	x	P .70
10	0	.0000
	1	.0001
	2	.0014
	3	.0090
	4	.0368
	5	.1029
	6	.2001
	7	.2668
	8	.2335
	9	.1211
	10	.0282

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