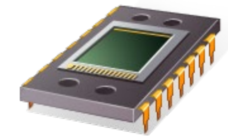
CASE: Parts from Two Vendors



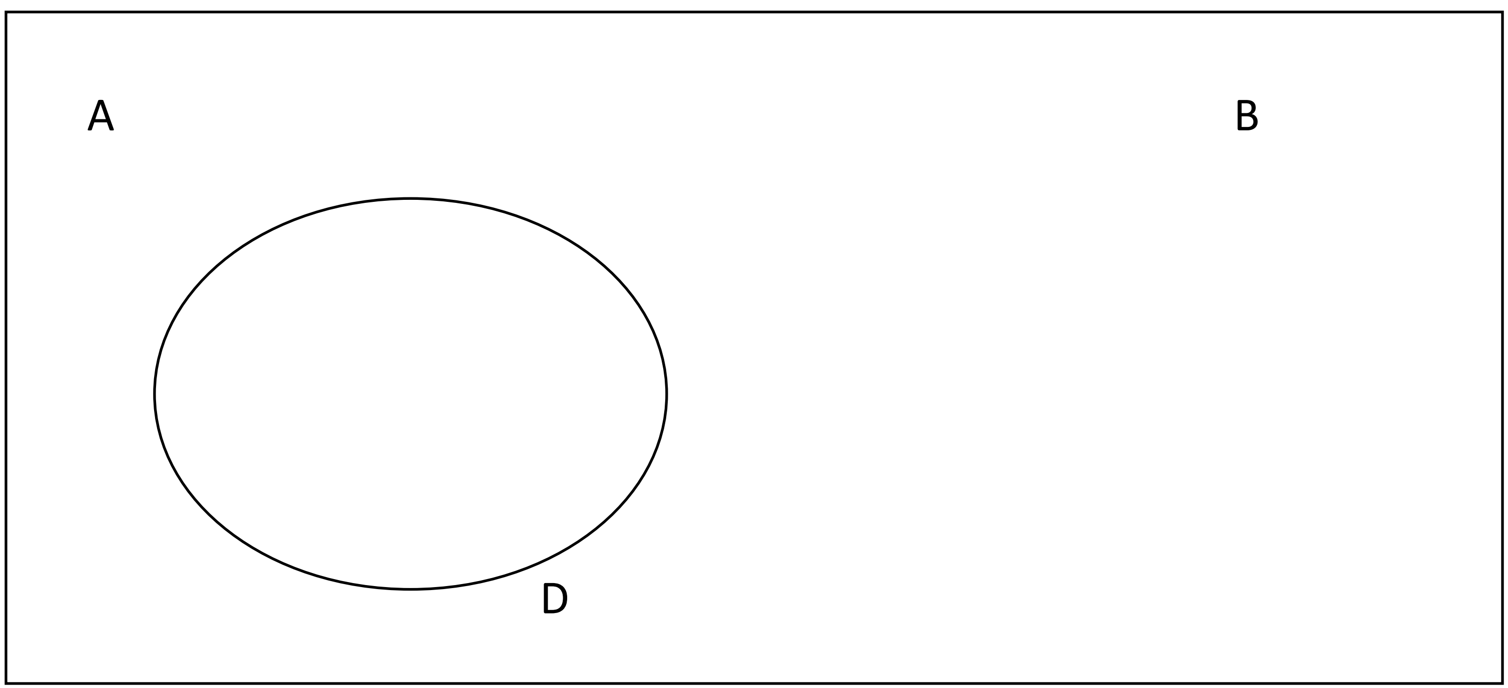
- A manufacturer buys parts from two vendors A and B.
- 25% of the parts come from Vendor A and 75% come from Vendor B.
- 10% of the parts from Vendor A are defective.
- 5% of the parts from Vendor B are defective.
- What is the overall percentage of parts that are defective?
- If a part was found to be defective what is the probability it came from Vendor A?

CASE: Parts from Two Vendors

A = Part is from Vendor A

B = Part is from Vendor B

D = Part is defective



Tree Diagrams

- Branch probabilities are conditional probabilities except at the root.
- Branch probabilities must add up to 1
(disjoint, all inclusive events)

To find the probability of an event E:

- Identify all paths that lead to E
- Multiply probabilities along each path
- Add those products to find P(E)

CASE: Parts from Two Vendors

A = Part is from Vendor A

B = Part is from Vendor B

D = Part is defective

$P(A)=0.25$

$P(B)=0.75$

$P(D|A)=0.10$

$P(D|B)=0.05$

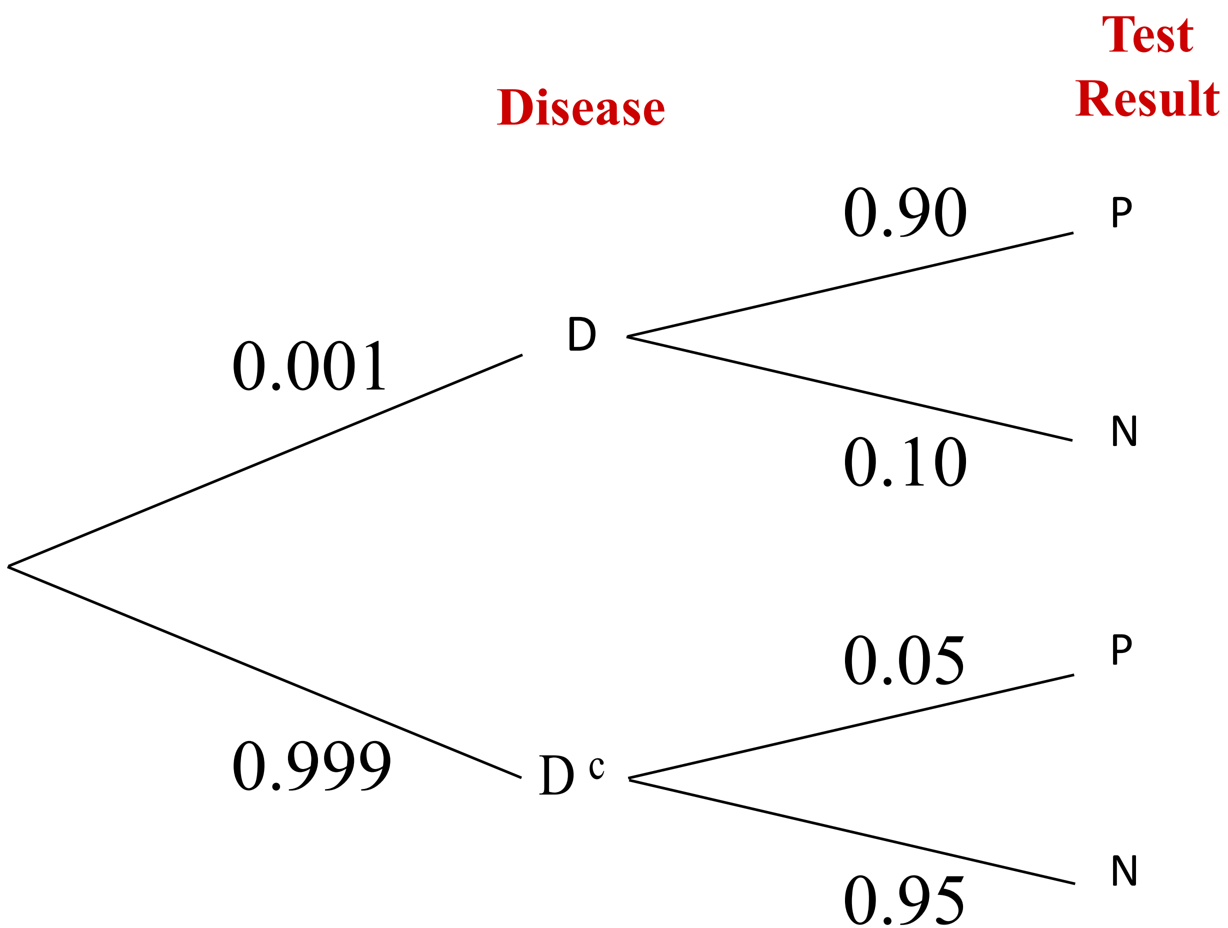
CASE: Testing for a Disease

This problem involves testing individuals for the presence of a disease. Suppose the probability of having the disease (D) is 0.001. If a person has the disease, the probability of a positive test result (P) is 0.90. If a person does not have the disease, the probability of a negative test result (N) is 0.95.

For a person selected at random:

- Find the probability of a negative test result given the person has the disease
- Find the probability of having the disease and a positive test result
- Find the probability of a positive test result
- Find the probability that a person who tested positive has the disease

Tree Diagram



Binomial Distribution

- There is a fixed number (n) of trials (Bernoulli Trials).
- Each trial has two possible outcomes (S=Success, F=Failure)
- The probability of success is p (the same for all trials)
- All trials are independent.
- The random variable of interest is the number of successes observed.

Rolling a Die

- A regular die is rolled 5 times.
  Let X = The number of six's rolled.

Rolling a Die

- A regular die is rolled 5 times.
  Let X = The number of six's rolled.
  X ~ B(n,p)   n=5   p=1/6

x_i	p_i

Binomial Distribution

BINOMIAL PROBABILITY

If X has the binomial distribution $B(n, p)$ with n observations and probability p of success on each observation, the possible values of X are $0, 1, 2, \ldots, n$. If k is any one of these values, the **binomial probability** is

$$P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$$

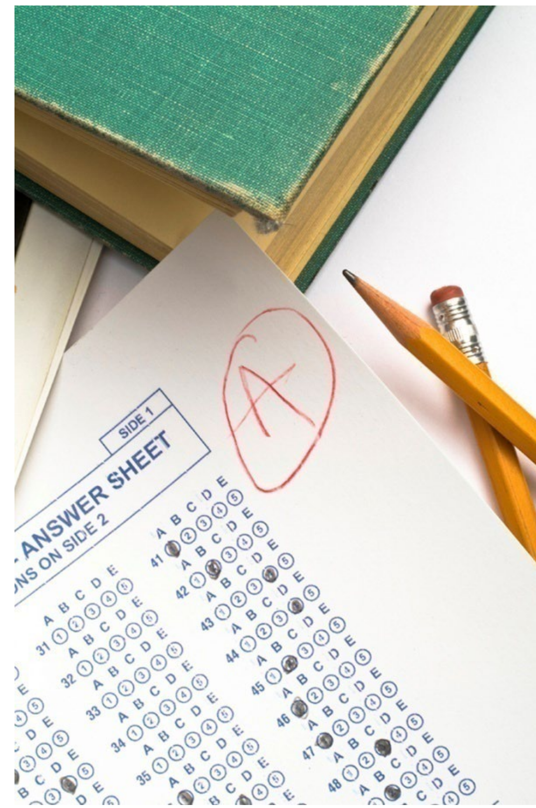
The number of ways of arranging k successes among n observations is given by the **binomial coefficient**

$$\binom{n}{k} = \frac{n!}{k!\,(n - k)!}$$

for $k = 0, 1, 2, \ldots, n$.

Multiple Choice Exam

- A student takes a multiple-choice exam, by “guessing” the answer to each question.
- Each question has 5 (equally likely) choices, and there are 10 questions on the exam sheet.
- All questions must be answered correctly to receive an A.
- At least 7 answers must be correct in order to receive a C.



Multiple Choice Exam

X = Number of correct answers

$P(X=10) =$

$P(X \geq 7) =$

Binomial Table

TABLE C Binomial Probabilities (continued)

Entry is $P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$

		p								
n	k	.10	.15	.20	.25	.30	.35	.40	.45	.50
9	0	.3874	.2316	.1342	.0751	.0404	.0207	.0101	.0046	.0020
	1	.3874	.3679	.3020	.2253	.1556	.1004	.0605	.0339	.0176
	2	.1722	.2597	.3020	.3003	.2668	.2162	.1612	.1110	.0703
	3	.0446	.1069	.1762	.2336	.2668	.2716	.2508	.2119	.1641
	4	.0074	.0283	.0661	.1168	.1715	.2194	.2508	.2600	.2461
	5	.0008	.0050	.0165	.0389	.0735	.1181	.1672	.2128	.2461
	6	.0001	.0006	.0028	.0087	.0210	.0424	.0743	.1160	.1641
	7			.0003	.0012	.0039	.0098	.0212	.0407	.0703
	8				.0001	.0004	.0013	.0035	.0083	.0176
	9						.0001	.0003	.0008	.0020
10	0	.3487	.1969	.1074	.0563	.0282	.0135	.0060	.0025	.0010
	1	.3874	.3474	.2684	.1877	.1211	.0725	.0403	.0207	.0098
	2	.1937	.2759	.3020	.2816	.2335	.1757	.1209	.0763	.0439
	3	.0574	.1298	.2013	.2503	.2668	.2522	.2150	.1665	.1172
	4	.0112	.0401	.0881	.1460	.2001	.2377	.2508	.2384	.2051
	5	.0015	.0085	.0264	.0584	.1029	.1536	.2007	.2340	.2461
	6	.0001	.0012	.0055	.0162	.0368	.0689	.1115	.1596	.2051
	7		.0001	.0008	.0031	.0090	.0212	.0425	.0746	.1172
	8			.0001	.0004	.0014	.0043	.0106	.0229	.0439
	9					.0001	.0005	.0016	.0042	.0098
	10							.0001	.0003	.0010
12	0	.2824	.1422	.0687	.0317	.0138	.0057	.0022	.0008	.0002
	1	.3766	.3012	.2062	.1267	.0712	.0368	.0174	.0075	.0029
	2	.2301	.2924	.2835	.2323	.1678	.1088	.0639	.0339	.0161
	3	.0852	.1720	.2362	.2581	.2397	.1954	.1419	.0923	.0537
	4	.0213	.0683	.1329	.1936	.2311	.2367	.2128	.1700	.1208
	5	.0038	.0193	.0532	.1032	.1585	.2039	.2270	.2225	.1934
	6	.0005	.0040	.0155	.0401	.0792	.1281	.1766	.2124	.2256
	7		.0006	.0033	.0115	.0291	.0591	.1009	.1489	.1934
	8		.0001	.0005	.0024	.0078	.0199	.0420	.0762	.1208
	9			.0001	.0004	.0015	.0048	.0125	.0277	.0537
	10					.0002	.0008	.0025	.0068	.0161
	11						.0001	.0003	.0010	.0029
	12								.0001	.0002

Used Car Dealership

- "Honest John" buys 20 used cars from a whole sale dealer (without prior inspection).
- From experience he knows that about 60% of the cars are "good" cars, that can be sold "as is" with a considerable profit, while the rest is pure junk.
- He needs to get at least 5 "good" cars in order to break even.
- His goal is to get at least 12 "good" cars.

Used Car Dealership

X = Number of “good” cars.

$P(X \geq 5) =$

$P(X \geq 12) =$