1. (10%) A private-label bottler of soft drinks asks each of 100 members of a tasting panel (who are regarded as a sample from a millions of potential customers) to rate each of two possible formulations of a cola drink on a 100-point scale; higher scores are desirable. Formulation G is less expensive, and will be used unless there is clear evidence that formulation R is preferred. From the data, the bottler contains the difference (R – G) in ratings for each panelist. State the null hypothesis that the two formulations are equally good on average, and an appropriate research hypothesis, based on the difference data. What are the consequences of false positive (Type I) or false negative (Type 2) error?
2. (10%) Based on previous problem (problem 1), and if under certain conditions, the **power** of the test is 0.60. What does this mean?
3. (15%) A Manufacturing facility is thinking to have a new changeover procedure for better cost saving. The current procedure requires an average of 16.2 worker-hours, with a standard deviation of 2.40 hours per changeover. They try 16 changeovers to see if the alternative is better.
   For $H_0 : \mu = 16.2, \alpha = 0.05$, with $\sigma = 2.40$ and $n = 16$. If $\mu = 14.6$, and what is the probability that the manager will retain the null hypothesis that the new procedure is no better than the old? Is this hypothesis test powerful?
4. A Drug company tests the average decrease in blood pressure using three drugs, for both female and male patients. A table of means, based on sufficiently large samples that we can ignore sampling error, is shown here.

	Gender		
	Female	**Male**	**Average**
A	10.8	12.8	11.8
B	9.8	10.4	10.1
C	8.2	9.2	8.7
Average	9.6	10.8	10.2

   a. (10%) Is there some degree of interaction between the drug and the gender factors?
   b. (5%) Construct a table of predicted means, using the **additive model** and the above data. Does a comparison of actual means and predicted means with additive model say anything about the interaction?

5. Suppose that the four inspectors at a film factory are supposed to stamp the expiration date on each package of film at the end of the assembly line. John, who

stamps 20% of the packages, fails to stamp the expiration date once in every 200 packages; Tom, who stamp 60 % of the packages, fails to stamp the expiration date once in every 100 packages; Jeff, who stamps 15% of the packages, fails to stamp the expiration date once in every 90 packages; and Pat, who stamps 5% of the packages, fails to stamp the expiration date once in every 200 packages. If a customer complains that her package of film does not show the expiration date, what is the probability that it is inspected by John? (8 %)

6. Three cards are drawn without replacement from the 12 face cards (jacks, queens, and kings) of an ordinary deck of 52 playing cards. Let X be the number of kings selected and Y be the number of jacks. Find
   (a) The joint probability distribution of X and Y. (6 %)
   (b) P[$(X, Y) \in$ A], where A is the region given by $\{(x, y) | x + y \geq 2\}$(4 %)

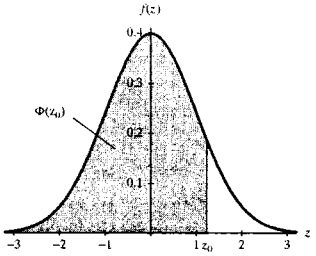
7. An electrical firm manufactures a 100-watt light bulb, which, according to specification written on the package, has a mean life of 900 hours with a standard deviation of 50 hours. At most, what percentage of the bulbs fail to last even 700 hours? Assume that the distribution is symmetric about the mean. (8 %)

8. A grade school boy have 5 blue and 4 white marbles in his left pocket and 4 blue and 5 white marbles in his right pocket. If he transfers one marble at random from his left to his right pocket, what is the probability of his then drawing a blue marble from his right pocket? (8 %)

9. Some biology students were checking the eye color for a large number of fruit flies. For the individual fly, suppose that the probability of white eyes is 1/4 and the probability of red eyes is 3/4, and that we may treat these observations as having independent Bernoulli trials. What is the probability that at least 4 flies have to be checked for eye color to observe a white-eyed fly? (8 %)

10. A roulette wheel used in a US casino has 38 slots of which 18 are red, 18 are black, and 2 are green. A roulette wheel used in a French casino has 37 slots of which 18 are red, 18 are black and 1 is green. A ball is rolled around the wheel and ends up in one of the slots with equal probability. Suppose that a player bets on red. If a $1 bet is placed, the player wins $1 if the ball ends up in the red slot (the player's $1 bet is returned). If the ball ends up in a black or green slot, the player loses $1. Find the expected value of this game to the player in
    (a) the US (b)France. (8 %)

The Normal Distribution



$$P(Z \le z) = \Phi(z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-w^2/2}\, dw$$

$$\Phi(-z) = 1 - \Phi(z)$$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7703	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9545	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

α	0.400	.0300	0.200	0.100	0.050	0.025	0.020	0.010	0.005	0.001
z_α	0.253	0.524	0.842	1.282	1.645	1.960	2.054	2.326	2.576	3.090
$z_{\alpha/2}$	0.842	1.036	1.282	1.645	1.960	2.240	2.326	2.576	2.807	3.291