IE 202 – Introduction to Probability
Quiz 2

Note that the last page is a table of Normal distribution values like Table A.3 in the text in case you need it.

Problem 1: (25 percent)

Assume that major crimes occur in a county occur according to a Poisson process. The rate of robberies is 17 per day. The murder rate is 0.67 per day. (While this may seem like a very high murder rate, these are the actual rates for Washington DC, computed over the period from 1960 through 2000. Welcome to our nation's capital!) Assume that the processes are independent.

a) What is the mean number of robberies over the course of a 7-day week?

b) What is the variance of the number of robberies over the course of a week?

c) What is the mean number of murders in a 7-day week?

d) What is the probability of there being **no** murders in a week?

e) What is the probability of there being exactly 5 murders in a week?

f) What is the probability of there being more than 5 murders?

Problem 2: 10 Percent *(Food for thought)*

The population of the United States is about 300 million people. Actually, we will hit that number sometime this summer. Many characteristics of people – height, weight, intelligence tests (for what they are worth), views on political issues, income, physical or sports capabilities – tend to be approximately Normally distributed.

Being 3 standard deviations from the mean of a normal distribution is viewed as being quite deviant or extreme in a statistical or probabilistic sense. With 300 million people in the US, about how many are 3 or more standard deviations away from the mean of whatever is being measured assuming the characteristic follows a Normal distribution?

Problem 3: (20 Percent)

A computer screen is composed of millions of tiny pixels. Sometimes a pixel will be defective (as is a pixel on my home computer screen).

The probability that a pixel will be defective is $2x10^{-7}$. Assume that whether or not any individual pixel works is *independent* of the probability of another pixel on the same screen working. A screen has a resolution that is 1600x1200 and so it is composed of 1,920,000 pixels.

a) Find the probability that a screen will have NO defective pixels.

b) Find the probability that a screen will have exactly ONE defective pixel.

c) A screen is deemed defective if two or more pixels are defective. What is the probability that a screen will be defective?

d) Screens are made in Singapore and shipped to the US in batches of 250 at a time. What is the (approximate) probability that the number of defective screens in a batch of 250 is 20 or less?

Problem 4: (25 Percent)

Washington University, in an effort to increase its apparent selectivity (which is the ratio of the number of accepted students to the number of applicants and which is a measure used by such ranking "services" as *US News and World Report*), has taken to mailing high school students **tons** of information. The goal is to induce mores students to apply, thereby increasing the denominator.

A (hypothetical) high school statistics class collected data on this and found that the number of mailings a student received from Wash U in her junior year followed a Poisson distribution with $\lambda = 0.75$ mailings per week.

a) What are the mean and variance of the number of mailings a student can expect over the course of a 40-week junior year?

b) What is the probability (approximate if necessary) that a student will receive more than 35 mailings during her junior year?

c) What is the approximate probability that a student will receive less than 20 mailings during her junior year?

d) What is the probability that it will be 3 weeks or more between two successive mailings that a student receives?

e) What is the probability that the time between the start of the junior year and when a student receives her 4^{th} mailing from Wash U is more than 6 weeks.

Problem 5: (20 percent)

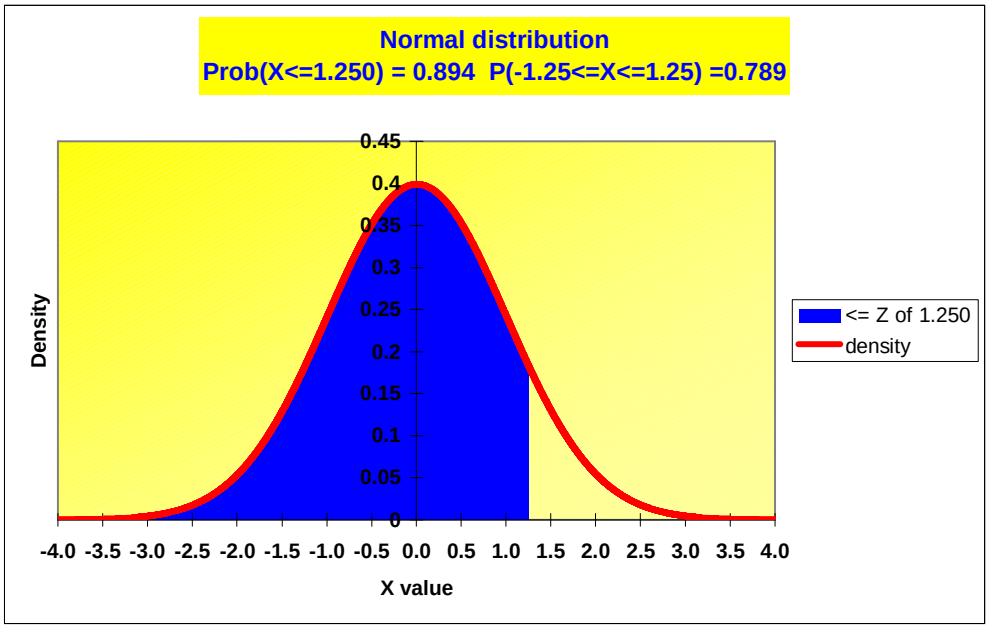
The time **in days** between house fires in a small rural community has been found to follow an exponential distribution with parameter $\mu = 0.025$.

a) What is the **mean** time in days between fires? What is the **standard deviation** of the time between fires?

b) What is the probability that the time between the first of the year (Jan 1) and the third home fire is 180 days or less.

c) The fire chief is very concerned about the rate of residential fires and so he initiates a public education program. In the 180 days (six months) after the end of the program, there were only 2 home fires. He argues that the program was successful and asks the town council to approve such a program on an annual basis. What is the probability of having 2 or fewer fires in a 180 day period *if the program had no effect whatsoever*? Based on this, do you think there is sufficient evidence to warrant making the program a permanent fixture of the community? **Show the probability and then briefly state whether you think the fire chief has a convincing argument for perpetuating the public education program.**

Work Page



	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	**0.5**	0.503989	0.507978	0.511967	0.515953	0.519939	0.523922	0.527903	0.531881	0.535856
0.1	0.539828	0.543795	0.547758	0.551717	0.55567	0.559618	0.563559	0.567495	0.571424	0.575345
0.2	0.57926	0.583166	0.587064	0.590954	0.594835	0.598706	0.602568	0.60642	0.610261	0.614092
0.3	0.617911	0.621719	0.625516	0.6293	0.633072	0.636831	0.640576	0.644309	0.648027	0.651732
0.4	0.655422	0.659097	0.662757	0.666402	0.670031	0.673645	0.677242	0.680822	0.684386	0.687933
0.5	0.691462	0.694974	0.698468	0.701944	0.705402	0.70884	0.71226	0.715661	0.719043	0.722405
0.6	0.725747	0.729069	0.732371	0.735653	0.738914	0.742154	0.745373	0.748571	0.751748	0.754903
0.7	0.758036	0.761148	0.764238	0.767305	0.77035	0.773373	0.776373	0.77935	0.782305	0.785236
0.8	0.788145	0.79103	0.793892	0.796731	0.799546	0.802338	0.805106	0.80785	0.81057	0.813267
0.9	0.81594	0.818589	0.821214	0.823814	0.826391	0.828944	0.831472	0.833977	0.836457	0.838913
1.0	**0.841345**	0.843752	0.846136	0.848495	0.85083	0.853141	0.855428	0.85769	0.859929	0.862143
1.1	0.864334	0.8665	0.868643	0.870762	0.872857	0.874928	0.876976	0.878999	0.881	0.882977
1.2	0.88493	0.88686	0.888767	0.890651	0.892512	0.89435	0.896165	0.897958	**0.899727**	0.901475
1.3	0.903199	0.904902	0.906582	0.908241	0.909877	0.911492	0.913085	0.914656	0.916207	0.917736
1.4	0.919243	0.92073	0.922196	0.923641	0.925066	0.926471	0.927855	0.929219	0.930563	0.931888
1.5	0.933193	0.934478	0.935744	0.936992	0.93822	0.939429	0.94062	0.941792	0.942947	0.944083
1.6	0.945201	0.946301	0.947384	0.948449	**0.949497**	**0.950529**	0.951543	0.95254	0.953521	0.954486
1.7	0.955435	0.956367	0.957284	0.958185	0.959071	0.959941	0.960796	0.961636	0.962462	0.963273
1.8	0.96407	0.964852	0.965621	0.966375	0.967116	0.967843	0.968557	0.969258	0.969946	0.970621
1.9	0.971284	0.971933	0.972571	0.973197	0.97381	0.974412	**0.975002**	0.975581	0.976148	0.976705
2.0	0.97725	0.977784	0.978308	0.978822	0.979325	0.979818	0.980301	0.980774	0.981237	0.981691
2.1	0.982136	0.982571	0.982997	0.983414	0.983823	0.984222	0.984614	0.984997	0.985371	0.985738
2.2	0.986097	0.986447	0.986791	0.987126	0.987455	0.987776	0.988089	0.988396	0.988696	0.988989
2.3	0.989276	0.989556	0.98983	**0.990097**	0.990358	0.990613	0.990863	0.991106	0.991344	0.991576
2.4	0.991802	0.992024	0.99224	0.992451	0.992656	0.992857	0.993053	0.993244	0.993431	0.993613
2.5	0.99379	0.993963	0.994132	0.994297	0.994457	0.994614	0.994766	**0.994915**	**0.99506**	0.995201
2.6	0.995339	0.995473	0.995603	0.995731	0.995855	0.995975	0.996093	0.996207	0.996319	0.996427
2.7	0.996533	0.996636	0.996736	0.996833	0.996928	0.99702	0.99711	0.997197	0.997282	0.997365
2.8	0.997445	0.997523	0.997599	0.997673	0.997744	0.997814	0.997882	0.997948	0.998012	0.998074
2.9	0.998134	0.998193	0.99825	0.998305	0.998359	0.998411	0.998462	0.998511	0.998559	0.998605
3.0	**0.99865**	0.998694	0.998736	0.998777	0.998817	0.998856	0.998893	0.99893	0.998965	0.998999
3.1	0.999032	0.999064	0.999096	0.999126	0.999155	0.999184	0.999211	0.999238	0.999264	0.999289
3.2	0.999313	0.999336	0.999359	0.999381	0.999402	0.999423	0.999443	0.999462	0.999481	0.999499
3.3	0.999517	0.999533	0.99955	0.999566	0.999581	0.999596	0.99961	0.999624	0.999638	0.99965
3.4	0.999663	0.999675	0.999687	0.999698	0.999709	0.99972	0.99973	0.99974	0.999749	0.999758