Summary of relevant probability distributions with examples of table usage and indication of application areas

Distribution	Example(s)	Applications
Normal distribution If X is $N(\mu,\sigma^2)$ or $N(\mu,\sigma)$	Suppose that 10 per cent of the probability for a certain distribution which is $\sim N(\mu,\sigma^2)$ is below 60 and that 5 per cent is above 90. What are the values of μ and σ? We have Prob (X ≤ 60) = 0.1, Prob (X ≤ 90) = 0.95 By "Key Fact" this implies Prob ((X- μ)/σ ≤ (60- μ)/σ) = 0.1 or Prob ((X- μ)/σ > (60- μ)/σ) = 0.90 and Prob ((X- μ)/σ ≤ (90- μ)/σ) = 0.95 or Prob ((X- μ)/σ > (90- μ)/σ) = 0.05 **From Table 4** (60- μ)/σ = -1.28 and (90- μ)/σ = 1.65 Solving we get μ = 73.1 and σ = 10.2, approximately	Key fact: $\frac{X-\mu}{\sigma} \sim N(0, 1)$ The main result, when sampling, is $\frac{\bar{x}-\mu}{\sigma/\sqrt{n}} \sim N(0, 1)$ When dealing with proportions we have, similarly and using the **Central Limit Theorem** $\frac{p-\mu_p}{\sigma_p} \rightarrow N(0, 1)$ as $n \rightarrow \infty$
Student's T (t) distribution t_n	(a) Let T have a t distribution with 10 *degrees of freedom*. Find Prob(|T| > 2.228) from Table 7 Answer: Prob(|T| > 2.228) = Prob(-2.228 < T or T > 2.228) so we	**Small samples from Normal Distribution *n < 30*, σ unknown**

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	can use the "two-sided test" element of table with ν = 10. We find Prob (|T| > 2.228) = 0.05. (b) If T has a t distribution with 20 degrees of freedom then, Prob (|T| > 2.086) = 0.05. (c) If T has a t distribution with 120 degrees of freedom then, Prob (|T| > 1.98) = 0.05. (d) If finally T has a t distribution with infinite degrees of freedom we get the Normal distribution so that Prob(|T| > 1.96) = 0.05.	$\frac{\bar{x}-\mu}{s/\sqrt{n}} \sim t_{n-1}$
Chi-Squared distribution. χ^2_ν , ν = degrees of freedom	Let X be χ^2_{10}. Then by Table 8[1] Prob (3.25≤X≤20.5) = Prob (X≥3.25) – Prob (X≥20.5) = 0.975 – 0.025 = 0.95	Later, we will use the fact that $\frac{(n-1)s^2}{\sigma^2} \sim \chi^2_{n-1}$ to obtain *Confidence Intervals* for σ^2 and we will have some other uses for χ^2_ν also.
F distribution $F_{\nu 1,\nu 2} = \frac{\chi^2_{\nu 1}/\nu_1}{\chi^2_{\nu 2}/\nu_2}$	Relevant table is Table 9. We omit an example of using this table for the moment.	Useful when dealing with situation of taking samples (sizes n_1 and n_2) from 2 different populations (standard deviations σ_1 and σ_2). It turns out that $\frac{s_1^2/\sigma_1^2}{s_2^2/\sigma_2^2} \sim F_{n_1-1,n_2-1}$

[1] Note: Mistake in Table 8 on Web pages– have mistakenly reproduced Page 17 twice. On the correct page 18, for ν = 10, then Prob (χ^2 > 20.4832) = 0.025. There are some copies of the tables in the library that you can check.