

true

2021-01-23



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KCD 2020



# Chapter 1

→ 1

## 1.1 (Kittler, 2019)

-10 10 .

$$y = \exp(x)$$

geom\_function() scale\_x\_continuous() -10 ~ +10 .

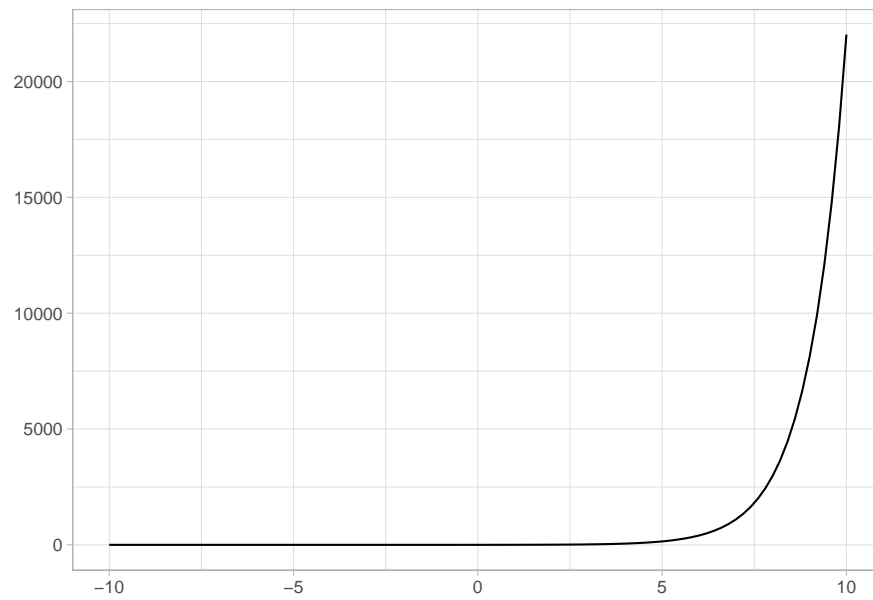
```
library(tidyverse)

# exp_tbl <- expand_grid(x_range = -10:10)
#
# exp_tbl %>%
#   ggplot(aes(x_range)) +
#     geom_density() +
#     geom_function(fun = function(x) exp(x))

ggplot() +
  geom_density() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) exp(x) ) +
  theme_light() +
  labs(x="", y="")
```

---

<sup>1</sup>Draw a function as a continuous curve



## 1.2

```
10  ggplot      . geom_function      . , latex2exp
    LaTeX ggplot      . 10      patchwork      .
```

- $y = x$
- $y = |x|$
- $y = x^2$
- $y = x^3$
- $y = x^4$
- $y = x^5$
- $y = \sqrt{x}$
- $y = \sqrt[3]{x}$
- $y = \frac{1}{x}$
- $y = \frac{1}{x^2}$

```
library(patchwork)
library(latex2exp)
theme_set(theme_minimal())

simple_eq_01 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
```



```

geom_function(fun = function(x) x, color="red" ) +
labs(title = TeX(c("y=x"))))

simple_eq_02 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) abs(x), color="blue" ) +
  labs(title = TeX(c("y=|x|"))))

simple_eq_03 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x^2, color="orange" ) +
  labs(title = TeX(c("y=x^2"))))

simple_eq_04 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x^3, color="black" ) +
  labs(title = TeX(c("y=x^3"))))

simple_eq_05 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x^4, color="darkgray" ) +
  labs(title = TeX(c("y=x^4"))))

simple_eq_06 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x^5, color="midnightblue" ) +
  labs(title = TeX(c("y=x^5"))))

simple_eq_07 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x^(1/2), color="pink" ) +
  labs(title = TeX(c("y = \\sqrt[2]_{x}"))))

simple_eq_08 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x^(1/3), color="violet" ) +
  labs(title = TeX(c("$y = \\sqrt[3]_{x}$"))))

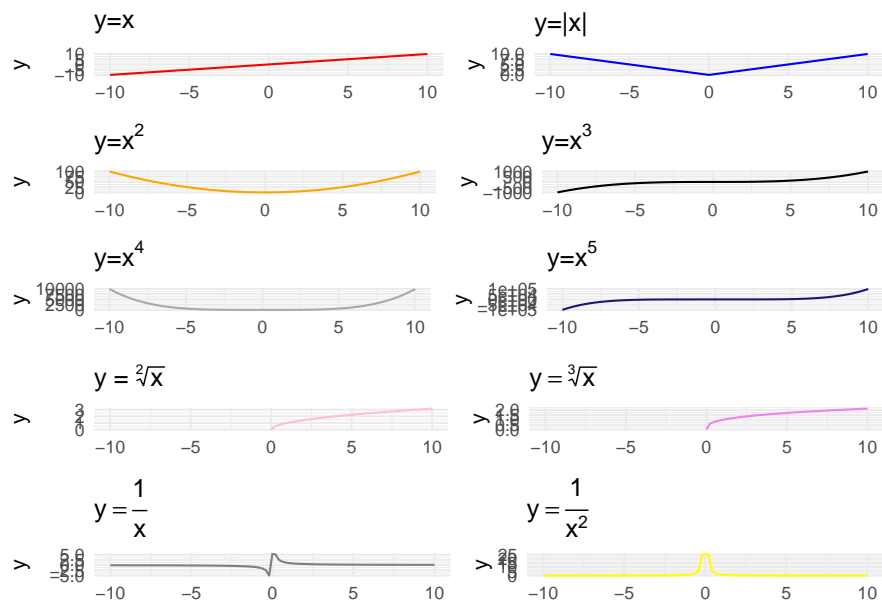
simple_eq_09 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) 1 / x, color="gray50" ) +
  labs(title = TeX(c("$y = \\frac{1}{x}$"))))

simple_eq_10 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +

```

```
geom_function(fun = function(x) 1 / (x)^2, color="yellow" ) +
labs(title = TeX(c("$y = \\frac{1}{x^2}$")))
```

```
( simple_eq_01 + simple_eq_02 ) /
( simple_eq_03 + simple_eq_04 ) /
( simple_eq_05 + simple_eq_06 ) /
( simple_eq_07 + simple_eq_08 ) /
( simple_eq_09 + simple_eq_10 )
```



### 1.3

- $y = x!$
- $y = 2^x$
- $y = \frac{1}{\sqrt{x}}$
- $y = \exp(-x)$
- $y = \log(x)$
- $y = \log_2(x)$
- $y = \log_{10}(x)$
- $y = x \times \log(x)$
- $y = \exp(x)$

- $y = \log(x)^2$

```

simple_eq_11 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) factorial(x), color="red" ) +
  labs(title = TeX(c("y=x!")))

simple_eq_12 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) 2^x, color="blue" ) +
  labs(title = TeX(c("y=2^x")))

simple_eq_13 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) 1 / sqrt(x), color="orange" ) +
  labs(title = TeX(c("y=\\frac{1}{\\sqrt{x}}")))

simple_eq_14 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) exp(-x), color="black" ) +
  labs(title = TeX(c("y=exp(-x)")))

simple_eq_15 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) log(x), color="darkgray" ) +
  labs(title = TeX(c("y=log(x)")))

simple_eq_16 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) log2(x), color="midnightblue" ) +
  labs(title = TeX(c("y=log_2 (x)")))

simple_eq_17 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) log10(x), color="pink" ) +
  labs(title = TeX(c("y = log_{10} (x)")))

simple_eq_18 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) x * log(x), color="violet" ) +
  labs(title = TeX(c("$y = x log(x)")))

simple_eq_19 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) exp(x), color="gray50" ) +

```

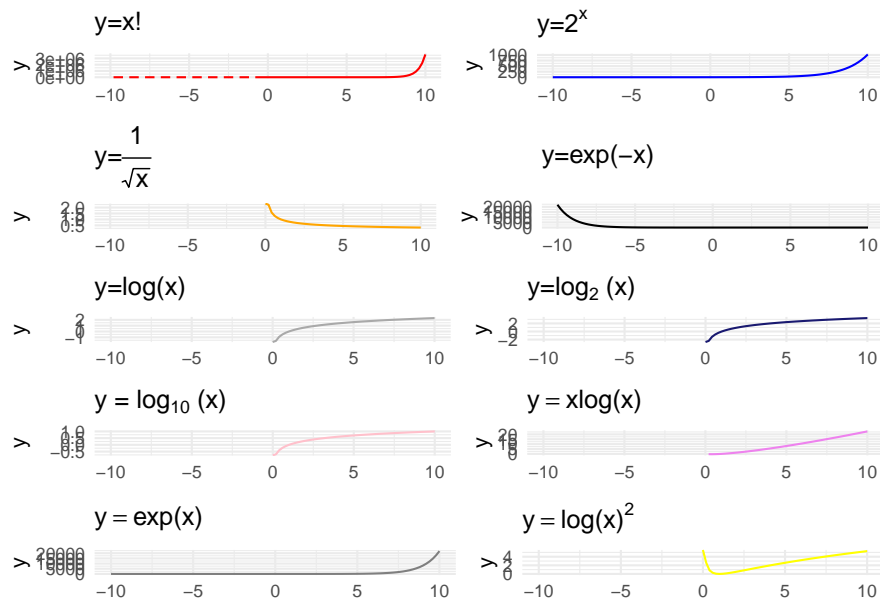
```

labs(title = TeX(c("$y = \exp(x)$"))))

simple_eq_10 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) log(x)^2, color="yellow" ) +
  labs(title = TeX(c("$y = \log(x)^2$"))))

( simple_eq_11 + simple_eq_12 ) /
( simple_eq_13 + simple_eq_14 ) /
( simple_eq_15 + simple_eq_16 ) /
( simple_eq_17 + simple_eq_18 ) /
( simple_eq_19 + simple_eq_10 )

```



## 1.4

(activation) .

1.  $y = \frac{1}{1+\exp(-x)} : \text{SigmoidFunction}$
2.  $y = \frac{10}{1+\exp(-x)} : 10X \text{SigmoidFunction}$
3.  $y = \tanh(x)$
4.  $y = \frac{\exp(x)}{\sum \exp(x)} : \text{Softmax}$

5.  $y = \text{rectifier}(x)$
6.  $y = \text{softplus}(x)$
7.  $y = \text{sign}(x)$
8.  $y = \text{floor}(x)$
9.  $y = \text{round}(x)$
10.  $y = \text{ceiling}(x)$

```

simple_eq_21 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) 1 / (1 + exp(-x)), color="red" ) +
  labs(title = TeX(c("y=\frac{1}{1+exp(-x)} : Sigmoid Function")))

simple_eq_22 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) 10 / (1 + exp(-x)), color="blue" ) +
  labs(title = TeX(c("y = \frac{10}{1+exp(-x)} : 10 X Sigmoid Function")))

simple_eq_23 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) tanh(x), color="orange" ) +
  labs(title = TeX(c("y= tanh(x)")))

simple_eq_24 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) exp(x) / sum(exp(x)), color="black" ) +
  labs(title = TeX(c("y = \frac{exp(x)}{\sum{exp(x)}} : Softmax")))

simple_eq_25 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) pmax(0, x), color="darkgray" ) +
  labs(title = TeX(c("y = rectifier(x)")))

simple_eq_26 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) log(1 + exp(x)), color="midnightblue" ) +
  labs(title = TeX(c("y= softplus(x)")))

simple_eq_27 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) sign(x), color="pink" ) +
  labs(title = TeX(c("y = sign(x)")))

simple_eq_28 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) floor(x), color="violet" ) +

```

```

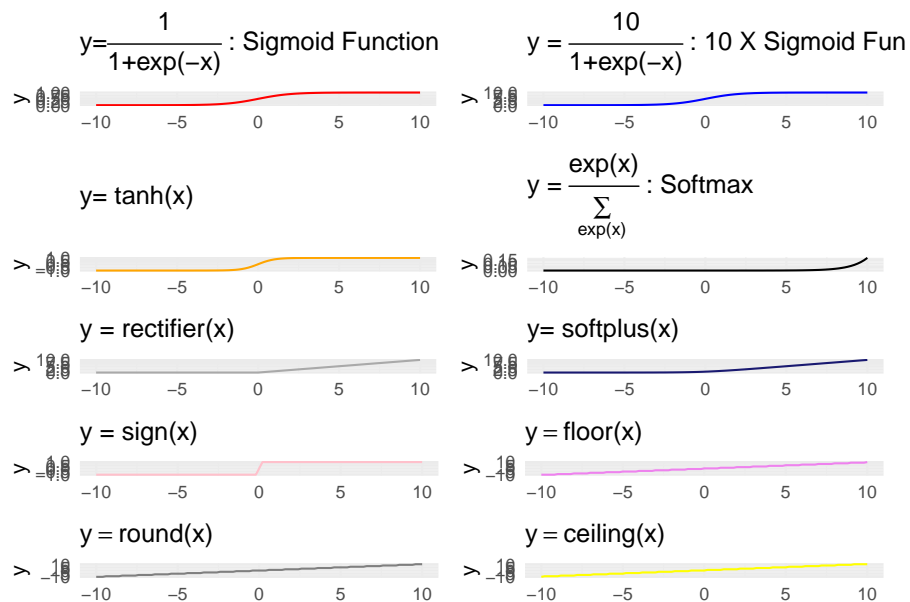
labs(title = TeX(c("$y = floor(x)")))

simple_eq_29 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) round(x), color="gray50" ) +
  labs(title = TeX(c("$y = round(x)$")))

simple_eq_30 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) ceiling(x), color="yellow" ) +
  labs(title = TeX(c("$y = ceiling(x)")))

( simple_eq_21 + simple_eq_22 ) /
( simple_eq_23 + simple_eq_24 ) /
( simple_eq_25 + simple_eq_26 ) /
( simple_eq_27 + simple_eq_28 ) /
( simple_eq_29 + simple_eq_30 )

```



## 1.5

(trigonometric) .

1.  $y = \sin(x)$

2.  $y = \sin(\pi * x)$
3.  $y = \sinh(x)$
4.  $y = \operatorname{asinh}(x)$
5.  $y = \cos(x)$
6.  $y = \operatorname{cospi}(x)$
7.  $y = \cosh(x)$
8.  $y = \operatorname{acosh}(x)$
9.  $y = \tan(x)$
10.  $y = \operatorname{tanpi}(x)$

```

simple_eq_31 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) sin(x), color="red" ) +
  labs(title = TeX(c("y = sin(x)")))

simple_eq_32 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) sinpi(x), color="blue" ) +
  labs(title = TeX(c("y = sin(pi*x)")))

simple_eq_33 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) sinh(x), color="orange" ) +
  labs(title = TeX(c("y= sinh(x)")))

simple_eq_34 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) asinh(x), color="black" ) +
  labs(title = TeX(c("y = asinh(x)")))

simple_eq_35 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) cos(x), color="darkgray" ) +
  labs(title = TeX(c("y = cos(x)")))

simple_eq_36 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) cospi(x), color="midnightblue" ) +
  labs(title = TeX(c("y = cospi(x)")))

simple_eq_37 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) cosh(x), color="pink" ) +
  labs(title = TeX(c("y = cosh(x)")))

```

```

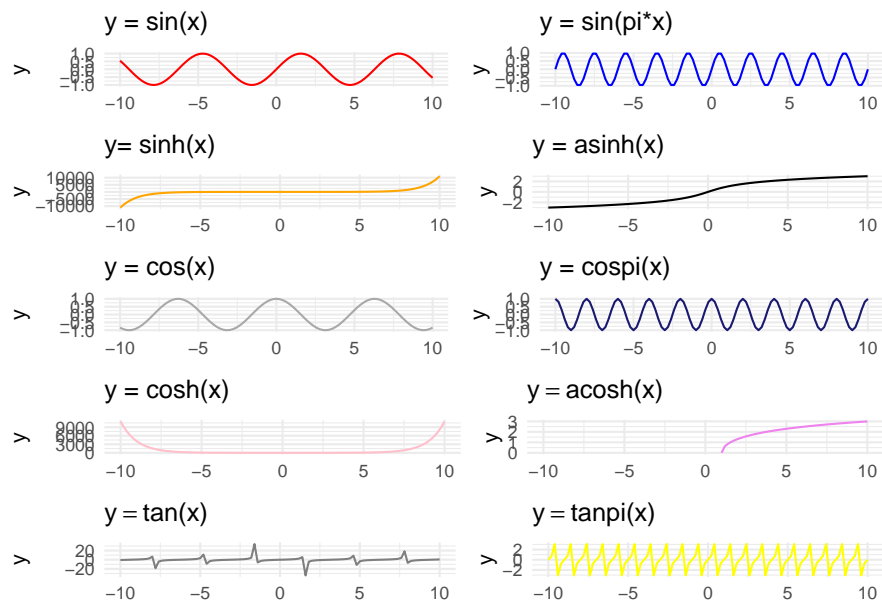
simple_eq_38 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) acosh(x),    color="violet" ) +
  labs(title = TeX(c("$y = acosh(x)")))

simple_eq_39 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) tan(x),      color="gray50" ) +
  labs(title = TeX(c("$y = tan(x)$")))

simple_eq_40 <- ggplot() +
  scale_x_continuous(limits = c(-10,10)) +
  geom_function(fun = function(x) tanpi(x),    color="yellow" ) +
  labs(title = TeX(c("$y = tanpi(x)")))

( simple_eq_31 + simple_eq_32 ) /
( simple_eq_33 + simple_eq_34 ) /
( simple_eq_35 + simple_eq_36 ) /
( simple_eq_37 + simple_eq_38 ) /
( simple_eq_39 + simple_eq_40 )

```





# Chapter 2

- (Prime Number): 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157, 163, 167, 173, 179, 181, 187, 191, 193, 197, 199, 211, 223, 227, 229, 233, 239, 241, 251, 257, 263, 269, 271, 277, 281, 283, 293, 307, 311, 313, 317, 331, 337, 347, 349, 353, 359, 367, 373, 379, 383, 389, 397, 401, 409, 419, 421, 431, 433, 439, 443, 449, 457, 461, 463, 467, 473, 479, 487, 491, 499, 503, 509, 521, 523, 527, 529, 533, 539, 547, 557, 563, 569, 571, 577, 581, 583, 587, 593, 599, 601, 607, 613, 617, 619, 623, 629, 631, 637, 641, 643, 647, 653, 659, 661, 667, 671, 673, 677, 683, 689, 691, 697, 701, 703, 707, 709, 713, 719, 727, 729, 731, 733, 737, 739, 743, 749, 751, 757, 761, 763, 767, 769, 773, 779, 781, 787, 791, 793, 797, 799, 803, 809, 811, 813, 817, 821, 823, 827, 829, 833, 839, 841, 843, 847, 853, 857, 859, 863, 869, 871, 873, 877, 881, 883, 887, 891, 893, 897, 899, 903, 907, 909, 911, 913, 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1359, 1361, 1363, 1367, 1369, 1371, 1373, 1377, 1379, 1381, 1383, 1387, 1389, 1391, 1393, 1397, 1399, 1401, 1403, 1407, 1409, 1411, 1413, 1417, 1419, 1421, 1423, 1427, 1429, 1431, 1433, 1437, 1439, 1441, 1443, 1447, 1449, 1451, 1453, 1457, 1459, 1461, 1463, 1467, 1469, 1471, 1473, 1477, 1479, 1481, 1483, 1487, 1489, 1491, 1493, 1497, 1499, 1501, 1503, 1507, 1509, 1511, 1513, 1517, 1519, 1521, 1523, 1527, 1529, 1531, 1533, 1537, 1539, 1541, 1543, 1547, 1549, 1551, 1553, 1557, 1559, 1561, 1563, 1567, 1569, 1571, 1573, 1577, 1579, 1581, 1583, 1587, 1589, 1591, 1593, 1597, 1599, 1601, 1603, 1607, 1609, 1611, 1613, 1617, 1619, 1621, 1623, 1627, 1629, 1631, 1633, 1637, 1639, 1641, 1643, 1647, 1649, 1651, 1653, 1657, 1659, 1661, 1663, 1667, 1669, 1671, 1673, 1677, 1679, 1681, 1683, 1687, 1689, 1691, 1693, 1697, 1699, 1701, 1703, 1707, 1709, 1711, 1713, 1717, 1719, 1721, 1723, 1727, 1729, 1731, 1733, 1737, 1739, 1741, 1743, 1747, 1749, 1751, 1753, 1757, 1759, 1761, 1763, 1767, 1769, 1771, 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2189, 2191, 2193, 2197, 2199, 2201, 2203, 2207, 2209, 2211, 2213, 2217, 2219, 2221, 2223, 2227, 2229, 2231, 2233, 2237, 2239, 2241, 2243, 2247, 2249, 2251, 2253, 2257, 2259, 2261, 2263, 2267, 2269, 2271, 2273, 2277, 2279, 2281, 2283, 2287, 2289, 2291, 2293, 2297, 2299, 2301, 2303, 2307, 2309, 2311, 2313, 2317, 2319, 2321, 2323, 2327, 2329, 2331, 2333, 2337, 2339, 2341, 2343, 2347, 2349, 2351, 2353, 2357, 2359, 2361, 2363, 2367, 2369, 2371, 2373, 2377, 2379, 2381, 2383, 2387, 2389, 2391, 2393, 2397, 2399, 2401, 2403, 2407, 2409, 2411, 2413, 2417, 2419, 2421, 2423, 2427, 2429, 2431, 2433, 2437, 2439, 2441, 2443, 2447, 2449, 2451, 2453, 2457, 2459, 2461, 2463, 2467, 2469, 2471, 2473, 2477, 2479, 2481, 2483, 2487, 2489, 2491, 2493, 2497, 2499, 2501, 2503, 2507, 2509, 2511, 2513, 2517, 2519, 2521, 2523, 2527, 2529, 2531, 2533, 2537, 2539, 2541, 2543, 2547, 2549, 2551, 2553, 2557, 2559, 2561, 2563, 2567, 2569, 2571, 2573, 2577, 2579, 2581, 2583, 2587, 2589, 2591, 2593, 2597, 2599, 2601, 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3019, 3021, 3023, 3027, 3029, 3031, 3033, 3037, 3039, 3041, 3043, 3047, 3049, 3051, 3053, 3057, 3059, 3061, 3063, 3067, 3069, 3071, 3073, 3077, 3079, 3081, 3083, 3087, 3089, 3091, 3093, 3097, 3099, 3101, 3103, 3107, 3109, 3111, 3113, 3117, 3119, 3121, 3123, 3127, 3129, 3131, 3133, 3137, 3139, 3141, 3143, 3147, 3149, 3151, 3153, 3157, 3159, 3161, 3163, 3167, 3169, 3171, 3173, 3177, 3179, 3181, 3183, 3187, 3189, 3191, 3193, 3197, 3199, 3201, 3203, 3207, 3209, 3211, 3213, 3217, 3219, 3221, 3223, 3227, 3229, 3231, 3233, 3237, 3239, 3241, 3243, 3247, 3249, 3251, 3253, 3257, 3259, 3261, 3263, 3267, 3269, 3271, 3273, 3277, 3279, 3281, 3283, 3287, 3289, 3291, 3293, 3297, 3299, 3301, 3303, 3307, 3309, 3311, 3313, 3317, 3319, 3321, 3323, 3327, 3329, 3331, 3333, 3337, 3339, 3341, 3343, 3347, 3349, 3351, 3353, 3357, 3359, 3361, 3363, 3367, 3369, 3371, 3373, 3377, 3379, 3381, 3383, 3387, 3389, 3391, 3393, 3397, 3399, 3401, 3403, 3407, 3409, 3411, 3413, 3417, 3419, 3421, 3423, 3427, 3429, 3431, 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3849, 3851, 3853, 3857, 3859, 3861, 3863, 3867, 3869, 3871, 3873, 3877, 3879, 3881, 3883, 3887, 3889, 3891, 3893, 3897, 3899, 3901, 3903, 3907, 3909, 3911, 3913, 3917, 3919, 3921, 3923, 3927, 3929, 3931, 3933, 3937, 3939, 3941, 3943, 3947, 3949, 3951, 3953, 3957, 3959, 3961, 3963, 3967, 3969, 3971, 3973, 3977, 3979, 3981, 3983, 3987, 3989, 3991, 3993, 3997, 3999, 4001, 4003, 4007, 4009, 4011, 4013, 4017, 4019, 4021, 4023, 4027, 4029, 4031, 4033, 4037, 4039, 4041, 4043, 4047, 4049, 4051, 4053, 4057, 4059, 4061, 4063, 4067, 4069, 4071, 4073, 4077, 4079, 4081, 4083, 4087, 4089, 4091, 4093, 4097, 4099, 4101, 4103, 4107, 4109, 4111, 4113, 4117, 4119, 4121, 4123, 4127, 4129, 4131, 4133, 4137, 4139, 4141, 4143, 4147, 4149, 4151, 4153, 4157, 4159, 4161, 4163, 4167, 4169, 4171, 4173, 4177, 4179, 4181, 4183, 4187, 4189, 4191, 4193, 4197, 4199, 4201, 4203, 4207, 4209, 4211, 4213, 4217, 4219, 4221, 4223, 4227, 4229, 4231, 4233, 4237, 4239, 4241, 4243, 4247, 4249, 4251, 4253, 4257, 4259, 4261, 4263, 4267, 4269, 4271, 4273, 4277, 4279, 4281, 4283, 4287, 4289, 4291, 4293, 4297, 4299, 4301, 4303, 4307, 4309, 4311, 4313, 4317, 4319, 4321, 4323, 4327, 4329, 4331, 4333, 4337, 4339, 4341, 4343, 4347, 4349, 4351, 4353, 4357, 4359, 4361, 4363, 4367, 4369, 4371, 4373, 4377, 4379, 4381, 4383, 4387, 4389, 4391, 4393, 4397, 4399, 4401, 4403, 4407, 4409, 4411, 4413, 4417, 4419, 4421, 4423, 4427, 4429, 4431, 4433, 4437, 4439, 4441, 4443, 4447, 4449, 4451, 4453, 4457, 4459, 4461, 4463, 4467, 4469, 4471, 4473, 4477, 4479, 4481, 4483, 4487, 4489, 4491, 4493, 4497, 4499, 4501, 4503, 4507, 4509, 4511, 4513, 4517, 4519, 4521, 4523, 4527, 4529, 4531, 4533, 4537, 4539, 4541, 4543, 4547, 4549, 4551, 4553, 4557, 4559, 4561, 4563, 4567, 4569, 4571, 4573, 4577, 4579, 4581, 4583, 4587, 4589, 4591, 4593, 4597, 4599, 4601, 4603, 4607, 4609, 4611, 4613, 4617, 4619, 4621, 4623, 4627, 4629, 4631, 4633, 4637, 4639, 4641, 4643, 4647, 4649, 4651, 4653, 4657, 4659, 4661, 4663, 4667, 4669, 4671, 4673, 4677, 4679, 4681, 4683, 4687, 4689, 4691, 4693, 4697, 4699, 4701, 4703, 4707, 4709, 4711, 4713, 4717, 4719, 4721, 4723, 4727, 4729, 4731, 4733, 4737, 4739, 4741, 4743, 4747, 4749, 4751, 4753, 4757, 4759, 4761, 4763, 4767, 4769, 4771, 4773, 4777, 4779, 4781, 4783, 4787, 4789, 4791, 4793, 4797, 4799, 4801, 4803, 4807, 4809, 4811, 4813, 4817, 4819, 4821, 4823, 4827, 4829, 4831, 4833, 4837, 4839, 4841, 4843, 4847, 4849, 4851, 4853, 4857, 4859, 4861, 4863, 4867, 4869, 4871, 4873, 4877, 4879, 4881, 4883, 4887, 4889, 4891, 4893, 4897, 4899, 4901, 4903, 4907, 4909, 4911, 4913, 4917, 4919, 4921, 4923, 4927, 4929, 4931, 4933, 4937, 4939, 4941, 4943, 4947, 4949, 4951, 4953, 4957, 4959, 4961, 4963, 4967, 4969, 4971, 4973, 4977, 4979, 4981, 4983, 4987, 4989, 4991, 4993, 4997, 4999, 5001, 5003, 5007, 5009, 5011, 5013, 5017, 5019, 5021, 5023, 5027, 5029, 5031, 5033, 5037, 5039, 5041, 5043, 5047, 5049, 5051, 5053, 5057, 5059, 5061, 5063, 5067, 5069, 5071, 5073, 5077, 5079, 5081, 5083, 5087, 5089, 5091, 5093, 5097, 5099, 5101, 5103, 5107, 5109, 5111, 5113, 5117, 5119, 5121, 5123, 5127, 5129, 5131, 5133, 5137, 5139, 5141, 5143, 5147, 5149, 5151, 5153, 5157, 5159, 5161, 5163, 5167, 5169, 5171, 5173, 5177, 5179, 5181, 5183, 5187, 5189, 5191, 5193, 5197, 5199, 5201, 5203, 5207, 5209, 5211, 5213, 5217, 5219, 5221, 5223, 5227, 5229, 5231, 5233, 5237, 5239, 5241, 5243, 5247, 5249, 5251, 5253, 5257, 5259, 5261, 5263, 5267, 5269, 5271, 5273, 5277, 5279, 5281, 5283, 5287, 5289, 5291, 5293, 5297, 5299, 5301, 5303, 5307, 5309, 5311, 5313, 5317, 5319, 5321, 5323, 5327, 5329, 5331, 5333, 5337, 5339, 5341, 5343, 5347, 5349, 5351, 5353, 5357, 5359, 5361, 5363, 5367, 5369, 5371, 5373, 5377, 5379, 5381, 5383, 5387, 5389, 5391, 5393, 5397, 5399, 5401, 5403, 5407, 5409, 5411, 5413, 5417, 5419, 5421, 5423, 5427, 5429, 5431, 5433, 5437, 5439, 5441, 5443, 5447, 5449, 5451, 5453, 5457, 5459, 5461, 5463, 5467, 5469, 5471, 5473, 5477, 5479, 5481, 5483, 5487, 5489, 5491, 5493, 5497, 5499, 5501, 5503, 5507, 5509, 5511, 5513, 5517, 5519, 5521, 5523, 5527, 5529, 5531, 5533, 5537, 5539, 5541, 5543, 5547, 5549, 5551, 5553, 5557, 5559, 5561, 5563, 5567, 5569, 5571, 5573, 5577, 5579, 5581, 5583, 5587, 5589, 5591, 5593, 5597, 5599, 5601, 5603, 5607, 5609, 5611, 5613, 5617, 5619, 5621, 5623, 5627, 5629, 5631, 5633, 5637, 5639, 5641, 5643, 5647, 5649, 5651, 5653, 5657,

```
      TRUE  
    }  
  }  
  is_prime(3)
```

```
[1] TRUE
```

1 ~ 100

```
library(tidyverse)  
  
natural_number <- 1:100  
  
prime_number_decision <- map_lgl(natural_number, is_prime)  
  
tibble(  
  = natural_number,  
  = prime_number_decision) %>%  
  reactable::reactable()
```

자연수 소수판정	
1	false
2	true
3	true
4	false
5	true
6	false
7	true
8	false
9	false
10	false

1 - 10 of 100 rows

Previous

1

2

3

4

5

...

10

Next

$N$

$N$

`. reactable`

.

```
library(reactable)
calculate_primes <- function(number) {

  natural_number <- 1:number

  prime_number_decision <- map_lgl(natural_number, is_prime)

  tibble(
    = natural_number,
    = prime_number_decision) %>%
    reactable::reactable(columns = list(
      = colDef(
        cell = function(value) {
          if (value == TRUE ) paste0("", value) else value
        },
```

```
style = function(value) {  
  color <- if (value == TRUE) {  
    "#008000"  
  } else{  
    "#e00000"  
  }  
  list(fontWeight = 600, color = color)  
}  
)  
))  
}  
  
calculate_primes(10)
```

자연수    소수판정

1	FALSE
2	TRUE
3	TRUE
4	FALSE
5	TRUE
6	FALSE
7	TRUE
8	FALSE
9	FALSE
10	FALSE

## 2.1.2

```
##
generate_primes <- function(number) {

  natural_number <- 1:number
  prime_number_decision <- map_lgl(natural_number, is_prime)

  decide_prime_tbl <- tibble(
    = natural_number,
    = prime_number_decision %>% as.integer + 1)

  return(decide_prime_tbl)
}

prime_tbl <- generate_primes(10)

##
lines <- tibble(number = prime_tbl %>% pull(``),
  x = seq(1, 10, by = 1),
  xend = x,
  y = rep(0, 10),
  yend = prime_tbl %>% pull(``))

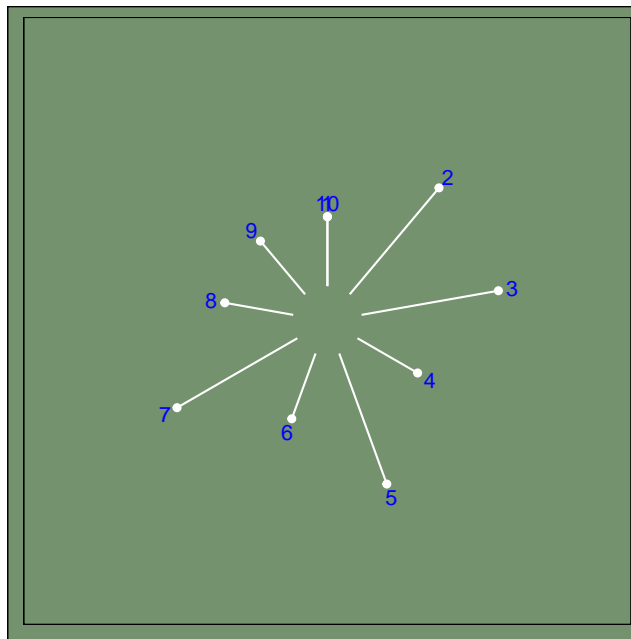
dots <- lines %>%
  select(x, yend)

## ----
lines %>% ggplot() +
  geom_segment(aes(x = x, xend = xend,
    y = y, yend = yend),
    color = "white") +
  geom_text(aes(x = x, y = yend + 0.2, label = number),
    color = "blue") +
  geom_point(data = dots,
    aes(x = x, y = yend),
    color = "white") +
  coord_polar() +
  ylim(-0.5, 3) +
  coord_polar() +
  theme(
    plot.background = element_rect(
      fill = "#75926f"),
    panel.background = element_rect(
      fill = "#75926f"),
```

```

panel.grid = element_blank(),
plot.caption = element_text(
  family = "Open Sans",
  size = 6,
  color = "white"),
axis.title = element_blank(),
axis.text = element_blank(),
axis.ticks = element_blank()
)

```



```

generate_primes <- function(number) {

  natural_number <- 1:number
  prime_number_decision <- map_lgl(natural_number, is_prime)

  decide_prime_tbl <- tibble(
    = natural_number,
    = prime_number_decision %>% as.integer + 1)
  return(decide_prime_tbl)
}

visualize_prime <- function(number) {

```

```

#

prime_tbl <- generate_primes(number)

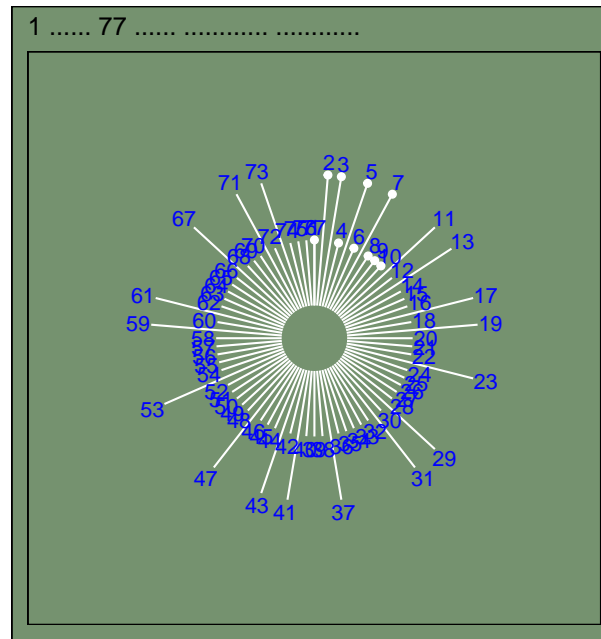
graph_tbl <- tibble( natural_number = prime_tbl %>% pull(``),
                    x               = seq(1, number, by = 1),
                    xend            = x,
                    y               = rep(0, number),
                    yend            = prime_tbl %>% pull(``)
)

dots <- lines %>%
  select(x, yend)

## ----
graph_tbl %>% ggplot() +
  geom_segment(aes(x = x, xend = xend,
                  y = y, yend = yend),
              color = "white") +
  geom_text(aes(x = x, y = yend + 0.2, label = natural_number),
            color = "blue") +
  geom_point(data = dots,
             aes(x = x, y = yend),
             color = "white") +
  coord_polar() +
  ylim(-0.5, 3) +
  coord_polar() +
  theme(
    plot.background = element_rect(
      fill = "#75926f"),
    panel.background = element_rect(
      fill = "#75926f"),
    panel.grid = element_blank(),
    plot.caption = element_text(
      family = "Open Sans",
      size = 6,
      color = "white"),
    axis.title = element_blank(),
    axis.text = element_blank(),
    axis.ticks = element_blank()
  ) +
  labs(title = glue::glue("1 {number} "))
}

visualize_prime(77)

```





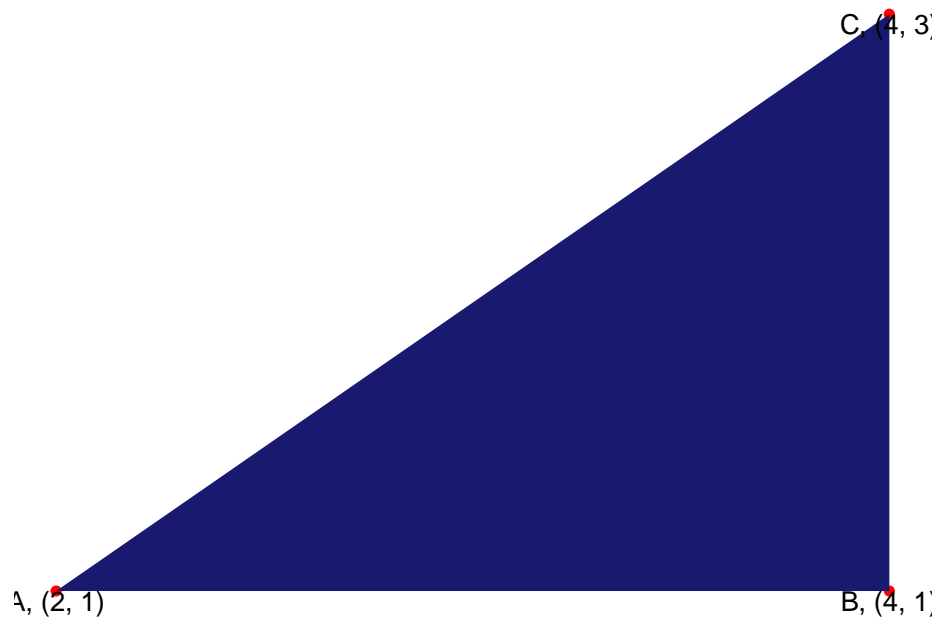
## Chapter 3

### 3.1

```
      point      ggplot      . geom_polygon()
      geom_text()
```

```
library(tidyverse)
triangle_tbl <- tibble(coord_x = c(2,4,4),
                      coord_y = c(1,1,3),
                      group    = c(1,1,1),
                      point     = c("A", "B", "C")) %>%
  mutate(point = glue::glue("{point}, ({coord_x}, {coord_y})"))

triangle_tbl %>%
  ggplot(aes(x      = coord_x,
            y      = coord_y,
            group   = group,
            label   = point)) +
  geom_point(size = 2, color = "red") +
  geom_polygon(fill = "midnightblue") +
  geom_text(vjust = 1, hjust = 0.5, size = 5) +
  theme_void()
```



## 3.2

```

ggplot() +
  geom_rect(data = rect_tbl, aes(xmin=bottom_left, xmax=bottom_right, ymin=top_left,
                                ymax=top_right))

```

```

rect_tbl <- tibble(bottom_left = 1,
                   bottom_right = 3,
                   top_left = 1,
                   top_right = 3)

rect_point_tbl <- rect_tbl %>%
  select(contains("left")) %>%
  rename(x=bottom_left, y=top_left) %>%
  bind_rows(
    rect_tbl %>%
      select(contains("right")) %>%
      rename(x=bottom_right, y=top_right)
  ) %>%
  mutate(point = c("A", "D")) %>%
  mutate(point = glue::glue("{point}:{x},{y}"))

ggplot() +
  geom_rect(data = rect_tbl, aes(xmin=bottom_left, xmax=bottom_right, ymin=top_left,
                                ymax=top_right))

```

```
geom_point(data = rect_point_tbl, mapping=aes(x=x, y=y), size = 2, color = "red") +
geom_polygon(fill = "midnightblue") +
geom_text(data = rect_point_tbl, mapping=aes(x=x, y=y, label = point), vjust = 1, hjust= 0.5,
theme_void() +
theme(legend.position = "none")
```



### 3.3 (circle)

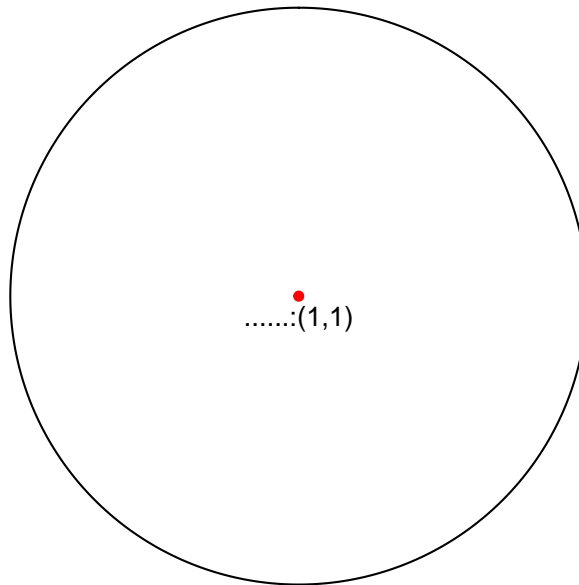
ggforce geom\_circle() (x,y) r .

```
library(ggforce)

circle_tbl <- tibble(x_pos = 1,
                    y_pos = 1) %>%
  mutate(center = glue::glue(" :({x_pos},{y_pos})"))

circle_tbl %>%
  ggplot(aes(x_pos, y_pos)) +
  geom_circle(aes(x0 = 1, y0 = 1, r = 1), inherit.aes = FALSE) +
  geom_point(size = 2, color = "red") +
  geom_text(aes(label = center), vjust = 1.5, hjust= 0.5, size = 5) +
  coord_fixed(ratio = 1) +
```

```
theme_void() +
theme(legend.position = "none")
```



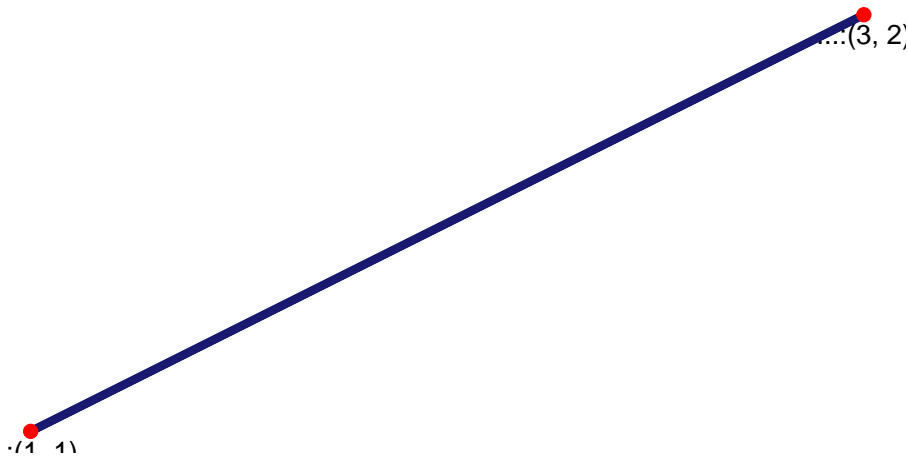
### 3.4 (line)

```
geom_segment()      ggplot      .
```

```
line_tbl <- tibble(x = c(1, 3),
                  y = c(1, 2)) %>%
  mutate(point = glue::glue(" :({x}, {y})"))

line_tbl %>%
  ggplot(aes(x, y, label = point)) +
  geom_segment(aes(x = line_tbl %>% select(x) %>% slice(1) %>% pull,
                  y = line_tbl %>% select(y) %>% slice(1) %>% pull,
                  xend = line_tbl %>% select(x) %>% slice(2) %>% pull,
                  yend = line_tbl %>% select(y) %>% slice(2) %>% pull),
              size = 2,
              linetype = 1,
              color = "midnightblue") +
  geom_point(size = 3, color = "red") +
  geom_text(vjust = 1.5, hjust = 0.5, size = 5) +
```

```
coord_fixed(ratio = 1) +
theme_void() +
theme(legend.position = "none")
```



## 3.5

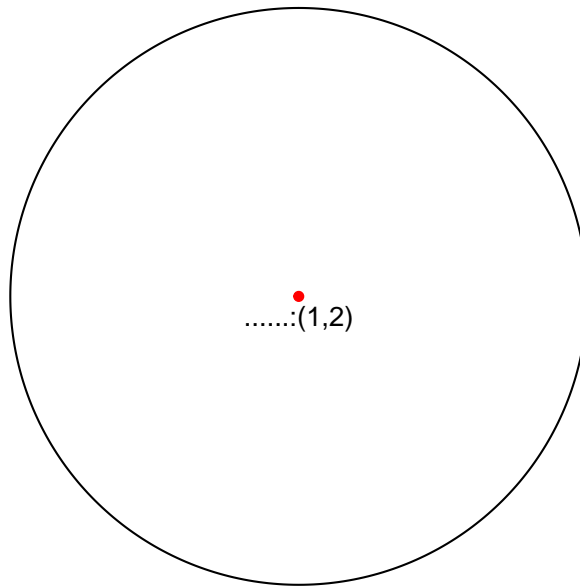
$x, y$   $r$

```
draw_circle <- function(x_pos, y_pos, radius) {

  circle_tbl <- tibble(x_pos = x_pos,
                      y_pos = y_pos) %>%
  mutate(center = glue::glue(" :({x_pos},{y_pos})"),
         radius = radius)

  circle_tbl %>%
    ggplot(aes(x_pos, y_pos)) +
    geom_circle(aes(x0 = x_pos, y0 = y_pos, r = radius), inherit.aes = FALSE) +
    geom_point(size = 2, color = "red") +
    geom_text(aes(label = center), vjust = 1.5, hjust = 0.5, size = 5) +
```

```
coord_fixed(ratio = 1) +  
theme_void() +  
theme(legend.position = "none")  
}  
  
draw_circle(1,2,2)
```



## Chapter 4

# Methods

We describe our methods in this chapter.





## Chapter 5

# Applications

Some *significant* applications are demonstrated in this chapter.

### 5.1 Example one

### 5.2 Example two



## Chapter 6

# Final Words

We have finished a nice book.



# Bibliography

Kittler, J. (2019). Overview of 40 mathematical functions in r.  
(2020). : .